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WORK ON THE CORINTH CANAL.

For centuries the Isthmus of Corinth, separating the Gulf of Corinth, which is about in the center of Greece, from the Gulf of Ægina, has attracted particular attention because of the barrier it presented to navigation between the Black and Adriatic Seas and the intermediate ports. A canal cutting the isthmus at its narrowest part was commenced by the Roman Emperor Nero, and the canal now being excavated is on a line nearly identical with the one adopted at that time. Three attempts, previous to Nero, had been made to build the canal, and at the Ægina end there is a depression about 130 feet wide at the bottom, and about 5,000 feet long, while at the west side the work can be traced for 6,500 feet from the shore. At intervals along the line are square shafts, the walls of which are perfectly preserved.

The route extends in a perfectly straight line, is 20,800 feet long, and the most formidable ridge encountered is 256 feet high. The canal will have the same width as that at Suez, 75 feet, and will shorten the voyage from the Adriatic Sea to Turkey and Asia Minor by 185 miles. Work was begun in May, 1882, under a contract with a firm for the total sum of $5,280,000. French capital is invested in the project.

The general plan of working is as follows: The approaches—about 600 feet on each side—will be deepened by the aid of land excavators, dredges, and pumps, the amount of material being about 3,330,000 cubic yards. The dredges are provided with both buckets and claws, so as to be operated in both mud and loose rock, and each will raise from 500 to 600 tons per day of twelve hours. The pump will raise from 2,300 to 2,600 cubic yards of sand per day. To open the main cut, a tunnel wide enough for a double line of rails is first driven through at an elevation of 154 feet above the sea level, after which vertical shafts will be sunk to the level of the tunnel.

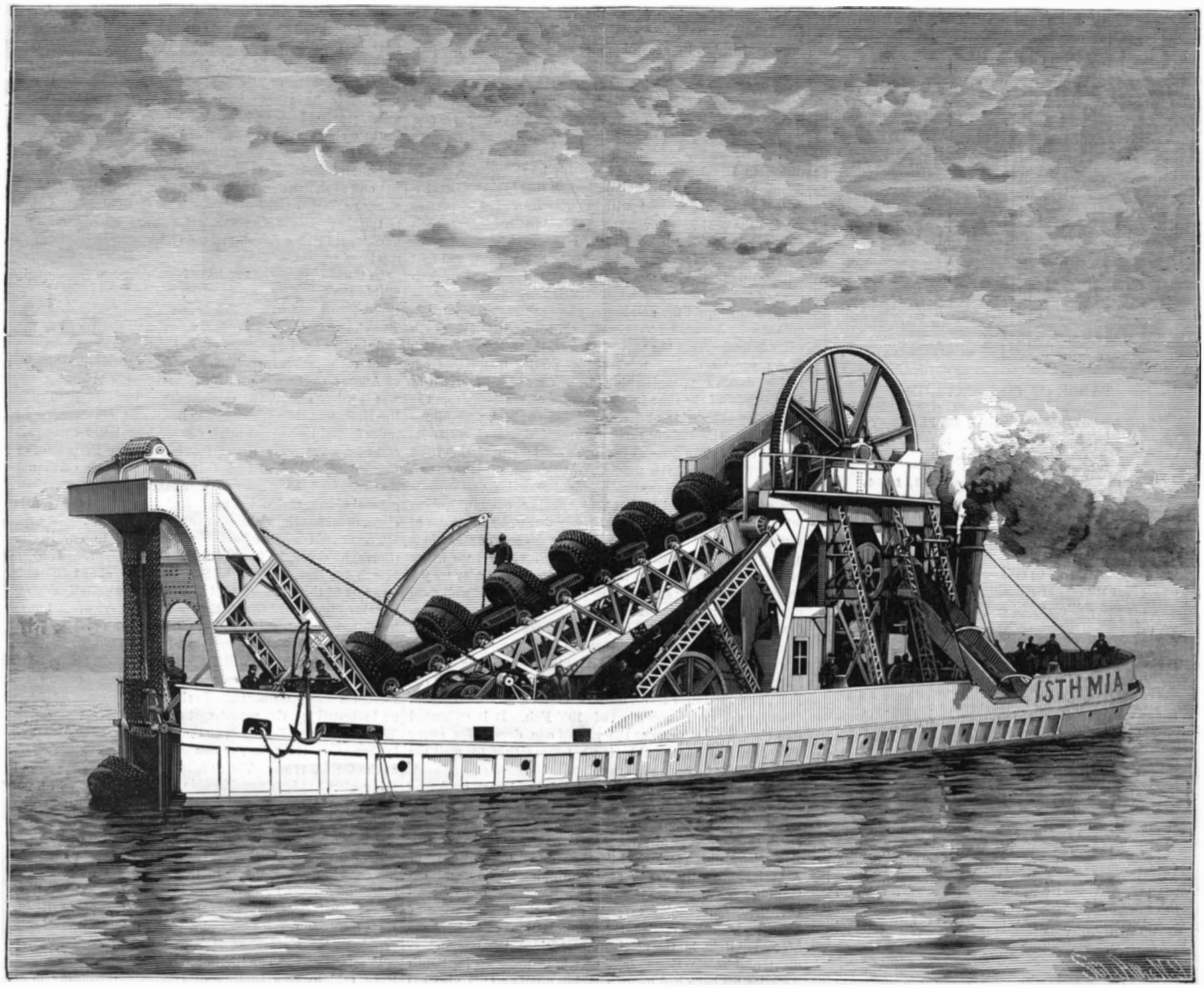
The tops of the shafts will be widened out on the line of the axis of the canal, the excavated material being thrown down the shafts to the tunnel, where trains remove it to the valleys adjoining the canal. That section remaining below the tunnel will be removed by drills and dynamite, working it in benches. Holes will be drilled about 160 feet deep and 4 inches in diameter—reaching to the bottom of the canal—and will be spaced from 6 to 13 feet apart, according to the nature of the material. The rock will be broken into small pieces and cast down into the bed of the canal, where it will be raised by powerful dredges and discharged into barges, which will carry it to sea and dump it. The total mass to be removed in the entire canal is 9,730,000 cubic yards, and it is estimated that 2,460,850 pounds of dynamite will be required.

Two 300 horse power marine dredges (one of which is illustrated upon this page), built by Demenge & Satre, of Lyons, France, are now at work upon the canal. The hull of the dredge is of iron, and is 129 feet long by 31·16 feet wide. The normal running speed of the buckets is fourteen per minute, or during a day of ten hours 8,400 bucket loads will be raised, this being equivalent to 7,560 cubic yards, since each bucket has a capacity of nine-tenths of a yard; but the average work for ten hours in gravel, in the Soane, was 6,500 cubic yards. The machinery is driven by two coupled engines of 150 horse power each. All the frame work and bracing are of iron. The bow of the hull is divided to permit the entrance of the bucket arm and the chain of buckets, and at each outer end is a frame, both of which are united at the top by a crosspiece that supports the pulleys carrying the chain by which the free end of the arm is raised or lowered. The excavated material is diverted by a central apron and chutes to either side of the dredge, where it is received by barges which are towed to sea as fast as filled.

The total population now connected with the work is 2,300. According to the present progress, it is expected that it will be completed in 1886. The total expenditure up to June 28 last was $1,700,000.

For the loan of the photograph from which our engraving was made, and for notes concerning the dredge, we are indebted to the courtesy of Mr. C. Colne, of the Interoceanic Canal Co.

THE project of cutting a ship canal across the province of Holstein, connecting the North Sea with the Baltic, is now being taken up by the German authorities in earnest. The canal is to run from near the mouth of the Elbe to the harbor of Kiel, Germany's chief naval port on the "Ostsee." It is to be constructed of such dimensions as to permit the largest ironclads in the German navy steaming from the Baltic to the German Ocean, or *vice versa*, thus avoiding the necessity of making, as at present, the long voyage round the peninsula of Jutland. Detailed drawings of on the subject are to be submitted to the new Reichstag.



THE CORINTH CANAL.—THE THREE HUNDRED HORSE POWER MARINE DREDGE ISTHMIA.

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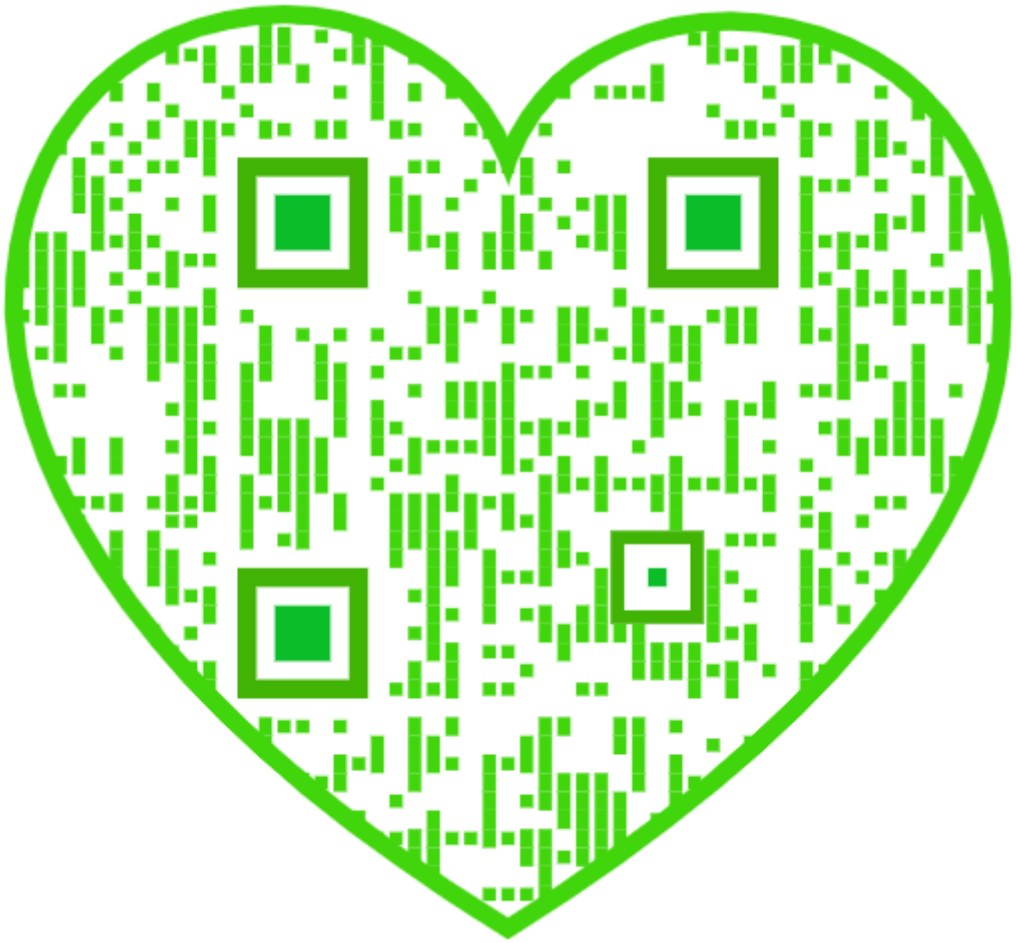

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THE EARTHQUAKE OF AUGUST 10.

Very few people living in the United States, except residents of the Pacific Coast, had ever felt a decided earthquake shock previous to the afternoon of Sunday, Aug. 10, when one was experienced on the Atlantic seaboard from Maine to Virginia, extending as far inward as West Virginia, and over the greater portion of Pennsylvania and New York. The shock was most severely felt on the south shore of Long Island, near New York city, and in the southern part of the city itself, and the adjacent coast of New Jersey, between 2:5 and 2:7 P.M. The length of its duration is variously given at from five to twenty seconds, the latter interval probably including the beginning and ending of the tremor, not so plainly perceptible as the very violent shaking so plainly perceived by every one for from five to seven seconds. There was no damage done of any consequence anywhere—only some glass and crockery broken, ceilings cracked, and loose chimney bricks dislocated—but the most massive buildings in New York were shaken to their foundations, and those who happened to be in third or fourth stories, or higher, felt that only slight additional force would have been needed to bring down many structures and cause great loss of life. As it was, in several parts of New York city, and at the points near by where the shock was most felt, people rushed from the houses in fright, which it took some time to allay.

The state of the weather just preceding the shock—in the particulars of which are found so many portentous omens and neglected warnings in the great earthquakes of history—excited no comment here. It was simply a continuation of the rather unseasonably cold and damp air we have had for several weeks, while Western Europe seems to have been getting our ordinary proportion of high temperature. There was a fresh northeast wind blowing, and the sky was cloudy, the thermometer registered 68° F., and the barometer 30·082 inches. The motion of the shock was lateral, not vertical, as has been more or less the case with the most destructive earthquakes, and its general direction was northeast and southwest. There was no observed tidal effect, vessels on the water not feeling it at all, except some tied up at docks broke their hawsers. A heavy rumbling sound, as of subterranean thunder, was almost everywhere heard, with greater or less distinctness, but in the city this was generally attributed to the rolling of heavy trucks on the pavement, or some similar cause, until after investigation showed the true cause.

The particular place where the earthquake originated affords room for no little speculation. We really know nothing about it, but in accepting any set of facts we are partially, also, adopting a certain theory as to the cause. The most prevalent opinion is that the starting point was not far from due east of New York city, and probably under the bed of the Atlantic. There are no facts to disprove, and many to support, the assumption that the interior of the earth is in a very highly heated state. If it is not in a fluid condition so largely as to interfere with its rigidity, which is counted equal to that of a ball of steel, this is said to be because of the great weight with which the exterior presses toward the center. Nevertheless it is steadily cooling, geologists claiming that it has required twenty-five millions of years to acquire its present externally solid form, and that during this period the mountains were formed and the hollows of the seas made, by a sort of wrinkling of the surface as the globe of liquid fire and heated gases contracted to its present shape. According to this idea the solid crust of the earth extends down from ten to forty miles, there being beneath that a greater or less thickness of plastic material, from melted rocks, etc., under high pressure, while the crust of the earth is all the time in a high state of tension, from the gradual cooling of the interior causing cavities, and allowing the superincumbent earth to crowd down closer to its heated core. The access of water, also, by percolation from the earth's surface to these subterranean ovens, it is thought, may in some cases cause explosions, dislocating vast quantities of material, and perhaps, by opening communication with the still hotter portion yet lower down, be the cause of some of the most destructive volcanoes. These explanations are largely hypothetical, but they accord with all we know of the earth's surface, and they afford the best theory we yet have to account for earthquakes and volcanoes, as well as to explain the present structural condition of the earth's surface. This crust of the earth we have hardly made a pin scratch upon; but we know that the further we go down the warmer it is, the artesian wells which supply the city of Paris from a depth of nearly 1,800 feet yielding water of 82° Fah., and the lower levels of the Comstock Mines having an almost uniform temperature of 130° Fah. It is estimated that the heat increases at the rate of one degree for every fifty feet, and this would give a temperature to melt the hardest rocks in less than ten miles.

On this theory the present volcanic and earthquake regions of the globe are located along the axis of these supposed wrinkles or corrugations from the contraction of the crust thought to be at present in the state of greatest tension. The most marked of these are down the east coast of Asia, including the Japan and Philippine Islands, and extending to Java, where the great earthquake of last year occurred. Another also extends down the Pacific coast of North and South America, the manifestations of which have been very light in the northern part since the commencement of historic times, but of whose presence in South America we have had many striking proofs. One also extends on an irregular parallel between the Himalayas and Indian Ocean; another near the coast line of South America on the Caribbean Sea; and another, which gives every evidence of having not many ages since been a region of most terrific activity, extends northward along the western coast of Africa, the Azores, Madeira, Canary, and Cape Verde Islands, largely consisting of extinct volcanoes, and suggesting that they may be the surviving surface of the fabled island or continent of Atlantis, once said to connect Africa with America. A smaller volcanic and earthquake region is found near the southern part of the Italian peninsula. All of these localities have been the scene of violent eruptions within comparatively recent times.

The great Java earthquake of August, 1883, was perhaps the most severe, when the Island of Krakatoa was almost bodily carried away, a part of it seemingly having been used to form two small new islands at some miles distant, and an indefinite portion sent into the atmosphere in such an atomized condition as to afford the best explanation we have had of the anomalous sunsets of the last year.

Italian earthquakes have been numerous enough to make a catalogue, one of the earliest recorded having been that which partially destroyed Herculaneum and Pompeii sixteen years before they were finally covered with lava from an eruption of Vesuvius. From 1773 to 1776 there were no less than 947 shocks, 500 of which were of the first degree of force. One in Calabria in 1783 was estimated to have caused the death of 100,000 persons, and was felt in a great part of Europe. The latest considerable one, at Ischia, was confined in narrow limits, causing only about 150 deaths. In 1857 a severe earthquake visited the kingdom of Naples, doing little damage in the city, but much in the provinces, and this earthquake was made specially memorable by the investigations relating to it made by Professor Mallet, of the British Association.

By using the fissures in buildings, the disturbance of heavy objects, etc., as natural measurers, he fixed, from 177 determinations, the focus of the disturbance as being beneath the village of Caggiora, finding the mean depth of the cavity at 5¾ miles. He also deduced the general form of the focal cavity as a curved fissure, 3 miles high, 9 miles long, and of very small thickness, the velocity of transit of shock being between 658 and 989 feet per second.

The great earthquake at Lisbon in 1755 was probably the most severe one felt in Europe outside of the Italian peninsula. The shock was felt in the Alps and on the coast of Sweden; 60,000 persons perished, and a part of the city permanently engulfed 600 feet beneath the bay. Among many others felt in Europe in 1878 was one which seems to have in many respects resembled the recent one here. It occurred on August 26, and was not remarkable for its violence, but for the great extent of territory affected. It is estimated to have covered over 2,000 geographical square miles, ringing bells and swaying houses and making cracks in the walls, and was accompanied by a dull subterranean noise; the workmen on the towers of the Cologne Cathedral saw the scaffolding oscillate and feared for their lives, yet not one of 1,100 miners working 1,000 feet below in the mines noticed the disturbance. This was not so severe even as the shock felt in England last Spring, when some chimneys were thrown down, and many walls so twisted as to be rendered unsafe.

In South America there have been numerous earthquakes within the last fifty years. Caraccas, in Venezuela, was entirely destroyed by three shocks, within fifty seconds, in 1812. The city of Quito, in Ecuador, was almost destroyed in 1859, and in 1868 a large part of Ecuador was devastated by a great earthquake, several shocks from the 13th to the 16th of August occurring over nearly all South America. This was the date also of the earthquake at Iquique, Peru, when the U. S. war ship Wateree was lifted and left stranded two miles inland by a great tidal wave. The latter earthquake caused a wave more than 2 feet high at San Francisco, and California itself has had many quite severe earthquake shocks. One that occurred there March 26, 1872, occasioned general alarm, and did a good deal of damage in San Francisco, cracking the walls of many fine buildings.

The nearest region of earthquake activity to our Eastern shores, however, is found in the West Indies. Here, on March 19, 1873, the city of San Salvador, about 300 miles due east of the southern part of Florida, was totally destroyed; three successive severe shocks were experienced, but the inhabitants had been so well warned by the previous noises that only some 500 lives were lost. The Atlantic States of the Union are thus, it will be seen, not very far removed from a region of recent volcanic activity, and belong to a section whose probable axis of seismic disturbance lies about as indicated by the recent earthquake, *i. e.*, between the West Indies and Bermuda on the one side and the Appalachian range on the other, somewhat according to the course of the Gulf Stream. The number of minor disturbances in this region has been considerable, but far the largest proportion of them have been so slight as almost to escape notice. The earthquakes already catalogued number about 9,000, and it is estimated that one occurs on an average twice a week somewhere in the world, but our section of the world has contributed very little to this list, nor does the earthquake of August 10 afford any idea that we are more likely to have such disturbances in the future, except as it suggests the ever present possibility, for us as well as all other people on the globe.

Proctor says: "The lifetime of a world like ours may be truly said to be a lifetime of cooling. Beginning in the glowing vaporous condition which we see in the sun and

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stars, an orb in space passes gradually to the condition of a cool, non-luminous mass, and thence steadily onward toward inertness and death. Regarding our planet's state as that of mid-life, we may call that stage death in which these conditions have entirely disappeared. Among these conditions is the action of the subterranean forces by which the earth's surface is continually modeled and remodeled. Only by the action of her vulcanian energies can the earth maintain her position as an abode of life. She is then manifesting her fitness to support life in those very throes by which, too often, many lives are lost. The upheavals and downsinkings, the rushing of ocean in great waves over islands and seaports, by which tens of thousands of human beings lose their lives, are part of the evidence which the earth gives that within her frame there still remains enough of vitality for the support of life during hundreds of thousands of years to come."

SMELTING AND CASTING OF IRON.

The metallurgical processes employed in the extraction of iron produce a metal which contains carbon, silicon, manganese, and other substances. Pure iron, having a very high fusing point, is not well applicable to foundry purposes; the material we have to examine is iron combined with carbon. The presence of carbon, it being combined and disseminated as graphite through the iron, causes a lowering of the fusing point. When pig iron is molten in a cupola furnace, the air comes in contact with particles of the liquid metal and the carbon thereof; the metal is partly decarbonized. The impurities, silicon, manganese, and small quantity of iron are converted into oxides, producing the slag.

Other products of oxidation, carbonic oxide and iron oxide, are dissolved in the molten iron. The air blown into the furnace generally contains aqueous vapor, and by its action upon burning coke hydrogen is generated. Molten iron, possessing the property of dissolving three times its volume of hydrogen, as has been shown by latest investigations, is thus charged with carbonic oxide, hydrogen, and iron oxide. On cooling of the metal the gases are emitted; they are the cause of the spongy, pumicestone-like surface structure observed on solidified metallic masses.

Iron being molten at a low temperature, and then tapped off and poured into moulds, liberates the dissolved gases within the mould. The structure of such a casting exhibits the presence of cavities and a high degree of porosity. Such cavities have pease-like shape near the surface, and assume that of a sphere toward the center of the metal; they are sometimes connected with each other by small channels. When heated more rapidly and far above its fusing point, iron becomes more applicable to foundry purposes. The molten metal remaining for some time in the ladle and being agitated by the aid of a bar before it is poured into the moulds, permits a free eliberation of dissolved gases.

The property of iron of absorbing gases and iron oxide is increased by remelting of iron; for homogeneous castings iron must be used which has not previously served the same purpose. The spongy structure of a casting is also caused by the moulding material. When the orifices of a mould become gradually filled with molten metal, the escape of gases depends on the physical nature of the moulding material. The latter containing moisture and organic substances generates aqueous vapor and other gases, which cause the formation of surface cavities. These cavities are covered with a film of oxidized metal, while those produced by dissolved gases have a bright metallic surface.

The difficulties involved in the casting of homogeneous articles are partly overcome by the use of a suitable porous sand. Another class of cavities is that called druse. The cavities of a druse are studded with iron crystals of a dendritic form. The formation of these cavities is caused by an abnormal shrinkage during solidification. Another phenomenon generally called sucking must be assigned to the same cause; it is generally observed on parts of castings where a large quantity of metal has been collected. It is therefore advisable in the manufacture of castings to give them an equal wall thickness, which has the advantage that the tension is most equally distributed throughout the mass. On cooling of the liquid metal within the mould, the particles which are in contact with the mould are sooner solidified than those more distant, and promote a motion of the liquid material from places of greatest to such of less accumulation, thus forming druses.—*Metallarbeiter.*

COOLING BY EVAPORATION.

The principle of cooling by evaporation is one on which some ice making machines are constructed; ether or aqua ammonia applied to the skin when heated produces a cooling effect by its rapid evaporation; a playing spray fountain in a room will sensibly cool the air from the same cause. Under favorable circumstances this principle may be economically applied to the cooling of overheated rooms. Many years ago the proprietor of a summer boarding house in eastern Massachusetts cooled his upper rooms in summer by spraying water through an air duct, the plan being almost identical with that described in an exchange as being employed in the composing room of the New Orleans *Picayune.* In this case a vertical wooden box was constructed in the corner of the room, with openings at the floor and ceiling, and furnished with a pipe for supplying water at the top, and a pan and drain at the bottom for receiving the flow and carrying it safely away. The supply pipe was bent over the upper end of the shaft, and fitted with a nose like that of a watering pot, so as to deliver a shower of spray instead of a solid stream. On connecting it with the service pipe the movement of the water was found to cause an active circulation of the air in that part of the room, which was drawn in at the upper opening of the shaft and issued again cool and fresh from the one at the floor level.

The relative temperatures of the water, the air at the top of the room, and the cooler air that had passed the water bath were: Water, 84°; air in the room, 96°; cooled air, 74°; showing that the air was cooled ten degrees below the temperature of the water which cooled it. This refrigeration was due to the rapid evaporation of the water by the heated air, the water being in the form of a fine spray.

THE EFFECT OF HARDENING ON STEEL.

A correspondent, in referring to an article on the "Contraction of Steel," in the SCIENTIFIC AMERICAN of July 12, says that steel workers differ as to the effect of fire and water on cast steel; some insisting that hardening expands the steel and others being certain that the process contracts it. Both of these conditions after hardening were alluded to in that article, and on these varying facts was based a suggestion that workers in steel keep a record of the behavior of the metal of the same bar, the same lot, and also of different makers.

The correspondent suggests that the managers of this paper institute and carry on to completion a comprehensive series of experiments to determine what changes, if any, are made in cast steel by the process of hardening. It is obvious that the proposition is not a feasible one; the duty of recording mechanical experiments is entirely distinct from the opportunity of making them or of conducting the processes of the trials.

But such trials and tests are being made by those who have not only all the ready means to make them, but are financially concerned in their results. The facts upon which the article in the July 12 issue was based were taken from very comprehensive tests made by a large manufacturer of steel tools, some of them necessarily of the most exact character. The variations in the behavior of steel from the same makers were almost incomprehensible, if the belief in the uniformity of the product was allowed; and the exact tests and records of the action of hardening on the steels of five of the foremost makers of steel in the world demonstrated the fact that at present there is no certainty in the homogeneousness of steel, so that it retains its certain and absolute character in the after workings. Of this general fact there can be no question; and producers of cast steel and workers of cast steel are acting quite in harmony, to the end that a uniform product may be obtained. The difficulties in the way of this desirable success are obvious enough; it is almost impossible, at present, to know the actual qualities of the iron and of the other added ingredients that go to make up the steel.

Not only do the ores from the same mine differ, but their after handling differs in quality of fuel and degrees of heat. And even the chemical products employed are not always the same in quality. When to these invitations to variation is added the carelessness of the forger and temperer, it is easy to see that only a long continued series of tests, carefully recorded, can ascertain the causes of difference and suggest the remedies. But there is going on a gradual improvement; and one of its evidences is the mechanical intelligence that demands special steel for special purposes. That this demand is met, at least in part, is evidence that an improvement in the methods of producing determinate qualities and similar, if not exact, results is possible.

Chemical Nature of Starch Grains.

Dr. Brukner has contributed to the "Proceedings of the Vienna Academy of Sciences" a paper on the "Chemical Nature of the Different Varieties of Starch," especially in reference to the question whether the granulose of Nägeli, the soluble starch of Jessen, the amylodextrin of W. Nageli, and the amidulin of Nasse, are the same or different substances.

A single experiment will serve to show that under certain conditions a soluble substance may be obtained from starch grains. If dried starch grains are rubbed between two glass plates, the grains will be seen under the microscope to be fissured, and if then wetted and filtered, the filtrate will be a perfectly clear liquid, showing a strong starch reaction with iodine. Since no solution is obtained from uninjured grains, even after soaking for weeks in water, Brukner concludes that the outer layers of the starch grains form a membrane protecting the interior soluble layers from the action of the water. He was unable to detect any chemical differences between the amidulin of Nasse, the portion of the starch grain soluble in water, and the granulose of C. Nägeli, which he extracted by means of saliva. The soluble filtrate from starch paste also contains a substance identical with granulose. Between the two kinds of starch—the granular and that contained in paste—there is no chemical but only a physical difference, depending on the condition of aggregation of their micellæ.

W. Nägeli maintains that granulose, or soluble starch, differs from amylodextrin in the former being precipitated by tannic acid and acetate of lead, while the latter is not. Brukner fails to confirm this difference, obtaining a voluminous precipitate with tannic acid and acetate of lead in the case of both substances. Another difference maintained by Nägeli, that freshly precipitated starch is insoluble, amylodextrine soluble, in water, is also contested; the author finding that granulose is soluble to a considerable extent in water, not only immediately after precipitation, but when it has remained for twenty-four hours under absolute alcohol. Other differences pointed out by W. Nägeli, Bruckner also maintains to be non-existent, and he regards amydulin and amylodextrin as identical.

Brucke gave the name erythrogranulose to a substance nearly related to granulose, but with a stronger affinity for iodine, and receiving from it not a blue but a red color. Brukner regards the red color as resulting from a mixture of erythrodextrin, and the greater solubility of this substance in water. If a mixture of filtered potato starch paste and erythrodextrin is dried on a watch glass, covered with a thin pellicle of collodion, and a drop of iodine solution placed on the latter, it penetrates very slowly through the pellicle, the dextrine becoming first tinctured with red, and the granulose afterward with blue. If, on the other hand, no erythrodextrin is used, the diffusion of the iodine causes at once simply a blue coloring.

With regard to the iodine reaction of starch, Brukner contests Sachsse's view as to the loss of color of iodide of starch at a high temperature. He shows that the iodide may resist heat, and that the loss of color depends on the greater attraction of water for iodine as compared with starch, and the greater solubility of iodine in water at high temperatures.

The different kinds of starch do not take the same tint with the same quantity of (solid) iodine. That from the potato and *Arum* gives a blue, that from wheat and rice a violet tint; while the filtrate from starch paste, from whatever source, always gives a blue color.

Salicylic Acid in Beer.

Some interesting experiments by Heinzelmann have been published, which offer additional proofs of the value of salicylic acid as a preservative agent, for they show that this antiseptic, when used judiciously, really strengthens and encourages the growth of yeast. The author's experiments show that, although the vitality of yeast is completely destroyed by the presence of 0·03 per cent of salicylic acid, the addition of only 0·01 per cent actually favors its greatest activity, and further, that the yeast cells developed in the presence of this proportion of salicylic acid are stronger and larger than those produced in a solution free from this acid; moreover, the production of alcohol in a given time is said to be greater. The addition of 1 part of salicylic acid to 10,000 parts of the mash is said to favor fermentation, especially when sugar is used.

In two series, each of three experiments, Ladureau employed (1) beer alone and beer mixed respectively with (2) 100 and (3) 200 grains per barrel. The three beers were exposed to the air for two weeks, and subsequently closed up for a month, after which period they were examined. The beer 1 without salicylic acid was sour, beer 2 was only slightly sour, and beer 3 not at all. To complete the investigation, the salicylated beer was employed for dietetic purposes for several weeks without any deleterious effect on the health of the experimenter. It is therefore clear that the addition at most of 250 grains (about one-half ounce) per barrel preserves the beer without affecting its use as a beverage. The author defends the use of salicylic acid, and maintains that a prejudicial amount would never be added, owing to the facility with which salicylic acid may be accurately estimated.

The Antiquity of Mercury.

A recent writer in the *North China Herald* discusses the part played by mercury in the alchemy and *materia medica* of the Chinese Cinnabar was known to them in the seventh century before the Christian era, and its occurrence on the surface of the earth was said to indicate gold beneath. Their views on the transformation of metals into ores and ores into metals by heat and other means took the form of a chemical doctrine about a century before Christ, and there is now no reasonable doubt that the Arabian Geber and others (as stated by Dr. Gladstone in his inaugural address to the Chemical Society) derived their ideas on the transmutation of metals into gold and the belief in immunity from death by the use of the philosopher's stone from China. Among all the metals with which the alchemist worked, mercury was pre-eminent, and this is stated to be really the philosopher's stone, of which Geber, Kalid, and others spoke in the times of the early Caliphs. In China it was employed excessively as a medicine. On nights when dew was falling, a sufficient amount was collected to mix with the powder of cinnabar, and this was taken habitually till it led to serious disturbance of the bodily functions. In the ninth century an emperor, and in the tenth a prime minister, died from overdoses of mercury. Chinese medical books say it takes two hundred years to produce cinnabar; in three hundred years it becomes lead; in two hundred years more it becomes silver, and then by obtaining a transforming substance called "vapor of harmony" it becomes gold. This doctrine of the transformation of mercury into other metals is 2,000 years old in China. The Chinese hold that it not only prolongs life, but expels bad vapors, poison, and the gloom of an uneasy mind.

MINERAL wool is used for a packing to deaden the sound between floors in buildings, and being incombustible it is now pretty generally used between the floors and ceilings in new houses. Mineral wool is obtained from the slag from blast furnaces, and is produced by throwing a jet of steam against the stream of slag as it flows from the furnace.

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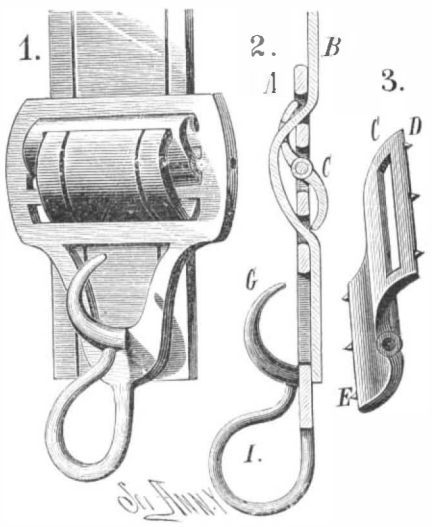
BACK BAND BUCKLE.

The main frame of the buckle is formed with two parallel transverse slots, through which the back band, B, passes from the back, and between which is a third slot in which is pivoted a clasp plate, Fig. 3, that curves in reverse directions at each side of its pivot to form the opposite clasping edges. The back band is passed through the slot in the plate, as shown in Fig. 1. It is apparent that any downward pull upon the buckle will act by the pressure of the band upon the upper half of the plate, and above its pivots to force the clasping edges firmly upon the band at the reverse sides of the frame. The edges, D E, are formed with prongs to secure a firmer hold of the buckle on the band.



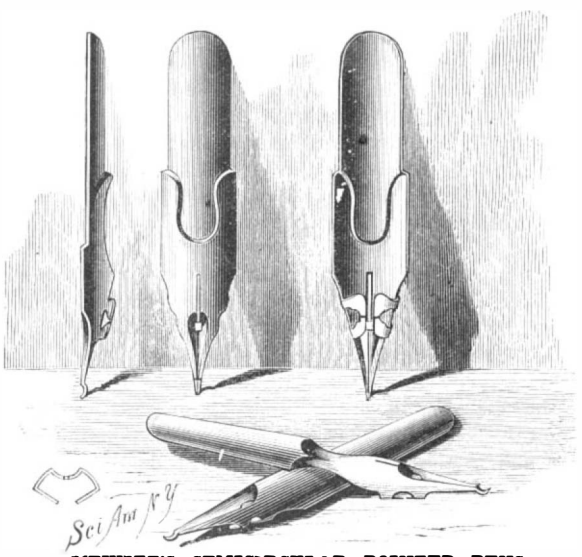
PENDER'S BACK BAND BUCKLE.

At the lower edge of the buckle frame is a downward extension, on the face of which is formed a hook, G, whose point reaches nearly to the plane of the face of the frame. By this means a space is secured between the main body of the hook and the frame in which the trace chain may be supported. In placing one of the trace links upon the hook, it may be pushed partly into the opening in the extension. A loop, I, formed on the extreme end of the extension serves to hold the rein up from the ground. The band passes over the animal's back, and carries a buckle with trace and rein hooks near each end and at each side of the animal The double hold of the clasp plate upon opposite faces of the band affords greater security against tearing and slipping than a single toothed edge acting on one face of the band would.

This invention has been patented by Mr. P. S. Pender, and further information can be obtained from Messrs. S. S. Nash & Co., of Tarboro, N. C.

SEMICIRCULAR POINTED PENS.

The accompanying illustration shows a new manner of making metallic pens, whereby their durability is increased, they will hold a greater quantity of ink than ordinary pens, and their points are so formed as to preclude scratching, no matter in what position the pen is held. The pen is made with slight projections or flaps attached to the edges of its body, and bent inward toward the concave portion to form an open reservoir. The small transverse section at the bottom indicates the manner in which these reservoir attachments are shaped to feed the ink to the point of the pen. The point is rounded or bulged to a half ball shape, allowing the pen to touch the paper with the same roundness whether held slantingly, flatly, or sideways, and write equally well



HEWITT'S SEMICIRCULAR POINTED PENS.

in any position, while the slit parts never form cutting edges, as is the case with ordinary pens, and the point of the pen is always supplied with ink, since it acts as a minute reservoir, which is constantly supplied with ink from the larger reservoir formed by the flaps at the side. This construction is very easily and cheaply made, as it can be done by striking up the metal after the pen blank is cut out.

This invention has been patented in all the principal European countries as well as in the United States.

For further information relative thereto, apply to Mr. H. Hewitt, 100 Charlotte Street, Birmingham, England.

GEOGRAPHICAL PUZZLES AND GAMES.

The system consists in teaching geography by means of peculiarly constructed maps, in connection with small wooden blocks upon the sides of which are printed the names and concise descriptions of capitals, cities, States, Territories, countries, etc. These blocks are constructed separately from the maps, but are made of suitable form and size to fit into holes or cavities in the faces of the maps, which holes are always made, in case of territorial divisions, within their limits, and in case of cities, etc., adjacent to marks which indicate the location of the place whose name and description are printed on the sides of the block.

When in use the map is spread upon a table, and the blocks inserted one by one in the holes where they properly belong. The operation of properly placing them forms a puzzle highly interesting and at the same time very instructive. A comparatively few repetitions of the effort suffices to render a child familiar with the names, location, and characteristics of all the places represented by the blocks.

The apparatus is made in series or sets of three parts each, each part consisting of a map and its appropriate blocks. Part No. 1 of the first series consists of map No. 1 and ninety-seven blocks, each block relating to one city. The map is an outline one of the United States, with the names of the States and Territories, principal mountains, lakes, rivers, oceans, gulfs, and bays printed upon its face. The location of capitals and important commercial centers is indicated by appropriate circular marks, adjacent to which are the holes for the reception of the blocks which bear the name and description of the places. Map No. 2 of series No. 1 is wholly an outline map, having no names of any kind printed upon its surface. Names and descriptions of all States, Territories, principal cities, and towns, rivers, lakes, bays, gulfs, oceans, mountains, caves, national parks, oil, coal, gold, and silver mining districts, etc., are printed upon the little wooden blocks, which number over two hundred and fifty.

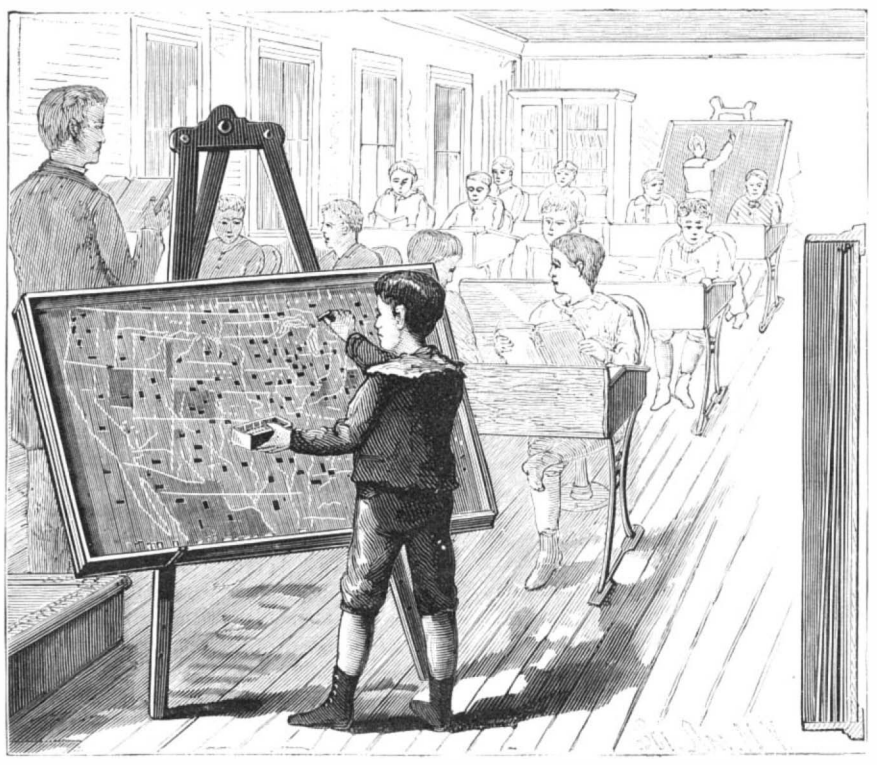
Map No. 3 of the 1st series has the same number of holes for blocks, but has all names printed on the map, while the blocks carry descriptive matter only, thus making it necessary to place the blocks with no guide to their proper places except the relation the descriptive matter bears to some name upon the map. Maps and appropriate blocks for each country in the world, and globes for the whole world, are issued on the same plan. The apparatus is constructed in special forms and size for use in kindergartens, in schools, and in the home circle.

Placing the little wooden blocks in their proper places in the maps forms a very interesting puzzle for a child working by itself. Two or more children may simultaneously work at it with the same map and blocks, and then they find themselves engaged in an interesting game wherein each is stimulated to excel the other in the number of blocks properly placed. When all blocks are in, and those placed by each are counted, the one having the larger number of correct locations is declared the winner of the game.

The puzzle or game plan may be pursued with equal advantage in school room and in the family circle.

Of the accompanying cuts, No. 1 represents the apparatus in use in a school room. Cut No. 2 shows the apparatus as made for use in the home circle. Cut No. 3 is a perspective view of the blocks. Any one desiring further information may get it by addressing the author of the system and manufacturer of the apparatus, William R. Norris, at 894 Sixth Avenue, New York.

NORRIS'S GEOGRAPHICAL PUZZLE AND GAMES.—Fig. 2.



NORRIS'S GEOGRAPHICAL PUZZLE AND GAMES.—Fig. 1.

DR. CARLOS FAREMBA, of Mexico, has addressed a circular letter to all representatives of foreign governments now in Washington, advocating the celebration of the discovery of America on its 400th anniversary, October 12, 1892, and the erection of a monument on the spot where the first landing was made.

A Solvent for Gums.

This invention relates to the production from petroleum of a substitute for bisulphide of carbon which can be used for extracting oils and anthracine, for dissolving gums, resins, and analogous substances, for waterproofing, and for vulcanizing India rubber in conjunction with chloride of sulphur or other vulcanizing agents. To obtain the improved substitute, which is called "Vulcoleine," take that distillate or fraction from petroleum which passes over between the temperatures of 100° and 212° Fahrenheit or thereabout (the fraction known as spirit or naphtha), and treat the same as follows: To every 100 gallons of petroleum add from two to three gallons of sulphuric acid with constant agitation, continued as long as may be necessary in a suitable vessel; it is then allowed to subside, and the liquor

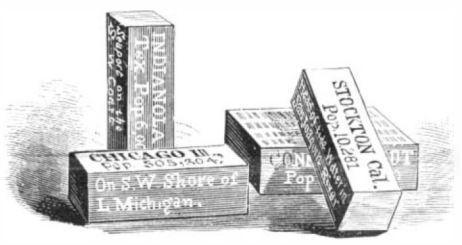


Fig. 3.

decanted from the sediment is run into a still with from one to two per cent or its weight of lime or other dehydrating medium, calcium carbonate, or other alkaline carbonates, or oxides of metals capable of removing or destroying any sulpho-oils which may have been generated by the treatment with sulphuric acid. The distillation is conducted without injecting steam or water into the contents of the still. Before distilling they sometimes submit the liquid to repeated treatment with fresh sulphuric acid until the acid ceases to be colored, or nearly so. As the distillate comes over, the receivers are exchanged as soon as the product which is coming over reaches a specific gravity from about 680 to 690, water being taken as 1,000. By these processes the portions of petroleum unsuited for a substitute for bisulphide of carbon are removed.

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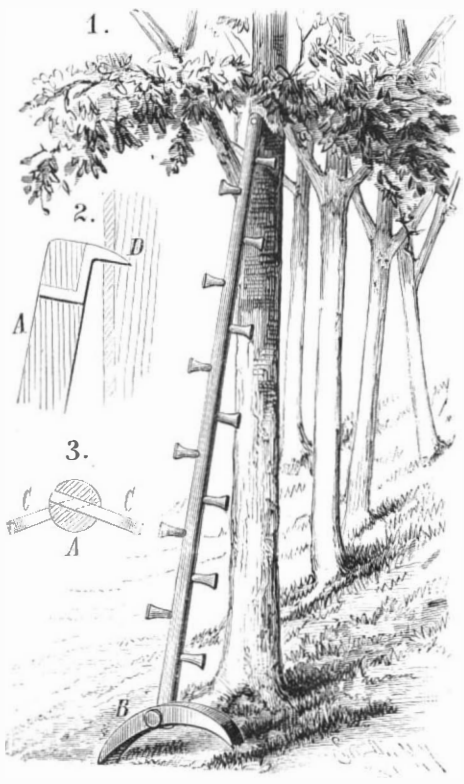
Solder for Aluminum.

Col. Wm. Frishmuth, of Philadelphia, Pa., says: The following receipts to solder aluminum have been tried by me and found practical. Take 10 parts silver, 10 parts copper, 20 parts aluminum, 60 parts tin, 30 parts zinc. The above solder is excellent for chains, etc., and can be used for the blowpipe operations. For a solder with the common solder iron, take either 95 parts of tin, 5 parts of bismuth; or 97 parts of tin and 3 parts of bismuth; or 98 parts of tin and 2 parts of bismuth; also 99 parts of tin and 1 part of bismuth; the fuse to use in all cases is either paraffine, stearine, vase line, balsam copaiba, benzine. Articles so soldered must be cleaned well before soldering, and the parts to be soldered must be heated to just enough to make solder adhere to the parts to be soldered. These alloys of solders, as above stated, can be changed to suit the operator.

POLE LADDER.

Pivoted to the lower end of the pole is a segmentally curved base piece, the concave edge of which faces downward; this permits of the ladder being inclined toward the object against which it rests. Projecting from the pole are outwardly inclined rings arranged alternately on opposite sides of the pole. On the upper end of the pole is a prong, D, that may be driven into the object against which the end of the ladder rests; but the main object of the prong is to aid in climbing the sides of a building, and to hook over a limb of a tree, which the pin just reaches, to support the ladder while picking the fruit. The curved base piece at all



JAYNE'S POLE LADDER.

times adjusts itself to the formation of the ground, giving the ladder a good, firm bearing.

This invention has been patented by Mr. John Jayne, of Forkston, Pa.

Post Mortem Diffusion of Arsenic.

Drs. Vaughan and Dawson, of the University of Michigan, have recently conducted some important experiments with the view of ascertaining if arsenious acid injected into the mouth or rectum after death would diffuse through the body. These observers not only found that such was the case, but that the diffusion was very extensive. The results of their investigations have, says the *Lancet*, a very important bearing on the question of arsenical poisoning. In the first place, it can no longer be contended that, because arsenic is found in quantity in the fluids and tissues of the body, therefore death was due to its administration; and in the second, a certain amount of immunity is given to the would-be murderer, inasmuch as there is the possibility of covering a homicidal act by using arsenic with the ostensible purpose of preserving or embalming the body. We say possibility, for such a procedure would almost to a certainty be defeated in its aim. At any rate, there would be no chance of success if the post mortem examination were conducted within a short time of death, when there would be the usual signs of inflammatory action in the alimentary canal; and again, in the face of other circumstantial evidence, the fact of the accused having resorted to such a particular mode of preserving the body would rather tend to confirm suspicion than to remove it.

That arsenic contained in soil may be dissolved in water and conveyed into the body has long been known. The researches of Drs. Vaughan and Dawson show what appears *a priori* as probable. During decomposition the relative humidity of different parts of the body, and of these with surrounding media, is constantly changing. Interstitial currents are passing through the tissues by osmotic action, and this liquid diffusion is naturally increased by the presence of crystalloid substances in solution; nor does it cease until the dialysis ends in an equilibrium of attraction which one fluid has for another, or presumably until post mortem disintegration is complete.

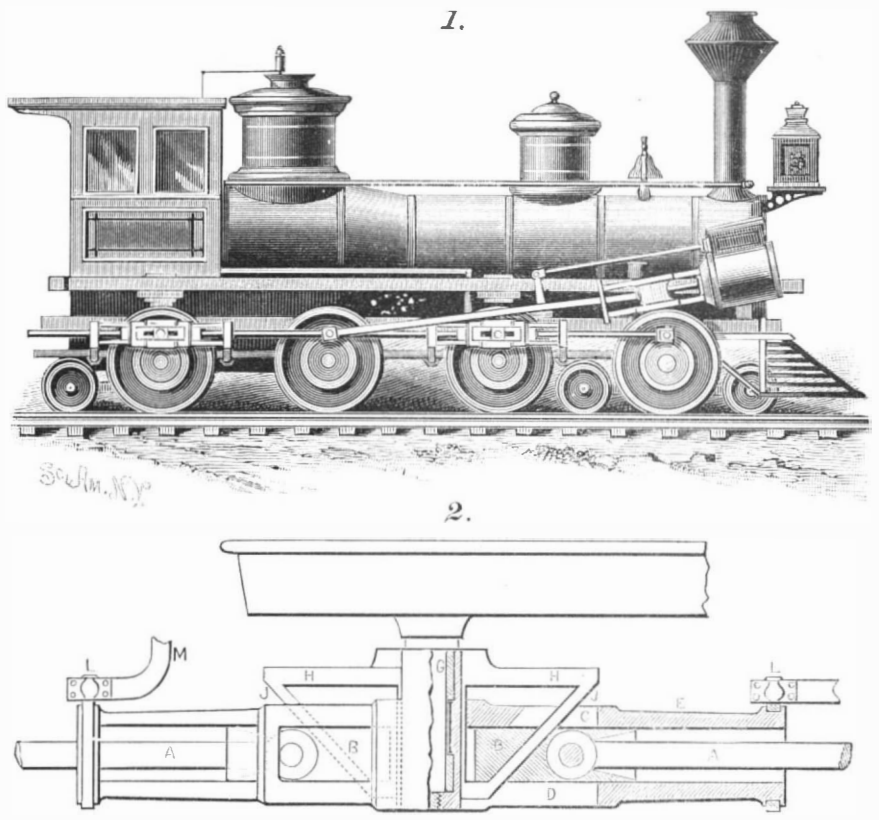
AN IMPROVED LOCOMOTIVE.

The accompanying illustrations represent a locomotive, recently patented by Mr. Gabriel Fretel, of Porto Real, Province de Rio Janeiro, Brazil, designed to be used on railroads having steep grades and sharp curves. The connecting rods are provided with devices for automatically lengthening or shortening them when the locomotive runs on curves, thus permitting of coupling a considerable number of driving wheels; this is accomplished by boxes mounted on the crank pins of the middle wheels of each frame, which are adapted to slide in the direction of the length of the pins. Fig. 1 is a perspective view of a locomotive embodying these principles; Fig. 2 is a plan view of the joint; and Fig. 3 is a plan view of the locomotive supporting frame and the truck frames.

The platforms of the locomotive and tender (the latter is not shown in the engravings) are supplied with pivots, V', for supporting them on four frames, A, in the middle of which the pivots are arranged. These frames are supported by pivots on trucks formed of the platform, B, supported by springs from the axle boxes. On the bottom of the box is a frame, B^2, in which are journaled the shafts carrying the small guide wheels, E, the load being so distributed as to rest entirely on the axle, C, and not on the guide wheels. The axle under each pivot is provided with fixed wheels, and is so arranged that it can slide laterally in its bearings. The cylinders are united by connecting rods, L, with the crank pins, L', on those wheels that are mounted on the axles between the wheels under the pivots, V', so that motion is transmitted by rigid connecting rods. The motion is then transmitted to the other wheels by extensible connecting rods. The automatic lengthening and shortening of the connecting rods can be accomplished in various ways, one of which is shown in Figs. 2 and 3. A sleeve, G, Fig. 2, is mounted on the crank pin in such a way that the pin can revolve within the sleeve, on which are triangular frames, H, on diametrically opposite sides. The shank, J, of the frame passes through a diagonal slot in the sliding block, B, sliding longitudinally in a box, E, mounted loosely on the sleeve and which slides in the direction of the length of the sleeve. The box is formed with slots, D, through which the diagonal shank of the frame passes. The connecting bars, A, are pivoted to the sliding blocks, and the outer ends of the boxes are pivoted by ball and socket joints to the bent ends of the shafts, U, Fig. 3.

When the locomotive runs on a curve the wheels will be about in the position shown in Fig. 3; the wheels of each platform remaining on the track in the usual manner, but the middle axle slides outward toward the rail having the longer radius. Looking at the locomotive from the front, the right hand connecting rod, M, Fig. 3, extending from the front to the rear wheels, will have to be lengthened, and the left hand rod will have to be shortened. As the axle moves to the right in relation to the platform, the sleeves and their frames will move in the same direction. In the right hand wheel the inclined arms of the frames press against the sides of the slots in the sliding boxes and move them toward the ends of the frames, which, turning on the ball and socket joints, lengthens the right hand connecting rod. At the left hand end of the axle the frame, acting on opposite sides of the grooves, will draw the sliding blocks toward the middle, thereby shortening the connecting rod. We have not space to describe in detail the other methods by which these results may be accomplished. The locomotive can be built with a single platform, or with two or more platforms pivoted to each other, and the platforms can be made of greater or less length, according to the curves on the road. By coupling several driving wheels the traction is increased—a point of great importance in locomotives running on mountain railways.

SOUTH of Long Island, beneath the Atlantic, are the remnants of a vast marsh. In clear water roots of trees can be seen from a boat, and in stormy weather masses of decayed wood and peat are thrown upon the shore.



FRETEL'S IMPROVED LOCOMOTIVE.

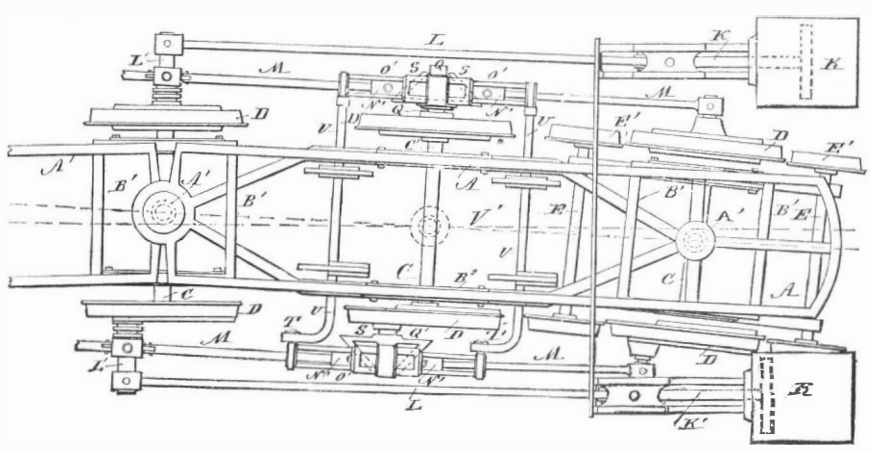


Fig. 3.—FRETEL'S IMPROVED LOCOMOTIVE.

An Ingenious Rat Trap.

A correspondent of the *Industrial World* describes a trap of his own contrivance as follows: This trap consists of a sheet iron pipe with a sort of rim on both ends and a strong two-bushel sack tied firmly around one end. Every hole is stopped in the corn crib but one, which opens into a feed box on the other side of the partition. Then the pipe is placed in the feed box and fitted, the open end firmly over the hole, allowing the sack to hang over the edge of the box into the manger. The trap is prepared, the door of the crib is left open, and the rats permitted to have their own way for an hour or so. Then the door is shut and a noise made to frighten the rats. Having but one means of escape, they rush into the pipe and down into the sack. This correspondent caught twenty-seven rats the first time he tried his trap.

Speaking between New York and Boston.

For some time past the American Bell Telephone Company, in connection with the Southern New England Telephone Company and the Metropolitan Telephone Company, of this city, have engaged in constructing in as perfect a manner as possible an experimental telephone line between this city and Boston, a distance of 225 miles. The experiments, we learn, have been highly successful, so much so that it is said to be easier to talk from New York to Boston on this new line than on the short circuits of the local lines in this city.

The improvement consists in using a metallic wire circuit, the two wires being twisted close to each other, but separated by an insulating material. Certain improved forms of transmitters are also used. By means of the double wire all extraneous sounds due to induced currents are eliminated, and as a consequence the sound of the voice comes out clear and distinct.

A few days ago Supt. Baker, of the Southern New England Company, at New Haven, Conn., stated that in a very short time the line would be thrown open to public use, and when that was done a person in New York could talk just as easily to his friend in Boston as to any one on the short lines in this city. He had talked to his wife at Stony Creek from New Haven, and they could hear each other just as distinctly as if they were both talking in New Haven.

In view of these improvements, it would seem as if it would be possible at no distant day to put New York in ready telephonic communication with all the principal cities in this country, and the wonder is that such service has not already been extended.

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Pneumatic Street Railway.

There has just been completed at the Risdon Iron Works, San Francisco, an experimental car to be run with compressed air by a new system, a trial of which was made recently. The subject is one of great interest, more especially as the system will be tried where close comparisons can be made between it and both cable and horse car as to relative economy. In the new plan there is a storage and charging pipe which carries the air below the surface of the road bed all along the route, contiguous to the track. Through a system of valves attached to this pipe, closely set together within the track, the pipe may be tapped and the receivers replenished at any and all points on the route. In this way the system is so arranged that the car is never removed from its source of supply, and has no determined distance to travel with each charge, so that it may have a minimum capacity as to storage room and pressure of air instead of the maximum, as when the length of the journey to the charge is absolute and fixed.

Compressed air motors have been run a definite distance without replenishing, as from end to end of a route and back, and suggestions have been made to run from station to station, using a pipe connection between, but in all cases provision has had to be made for carrying the heaviest possible load of passengers under the most adverse circumstances likely to occur, such as those arising from very frequent stoppages, bad condition of the track, accidental delays, etc. The definite points could not be passed without refilling the receivers, and either the engineer had to go or the motor itself had to be taken to the station off from the main line in the act of refilling, this system of operation leading to all the difficulties which have heretofore surrounded the use of compressed air as a motive power for street roads. No practical system has been put in use so far by which the motor could be resupplied with air at any and all points on the route.

The motor which has just been tried is constructed as an open car, after the style of the cable road dummies, and the air receivers are placed under the seats. From these receivers, which are connected by a pipe, a hose connection is made which terminates in a metal nozzle, in the end of which is fitted a valve to make connection with the service pipe, as described hereafter.

The main service pipe is placed underground, near the track, and is large enough to have in itself storage capacity sufficient to insure that the drawing off of each charge for the motors will not greatly decrease the pressure. It is thought that a pipe of five or six inches diameter will do for roads running cars five minutes apart, while it should never be less than four inches in diameter.

This main pipe is provided with right angled branches, say every 300 feet more or less, which lead to the center of the track and terminate in valvular outlets. The nozzle connected with the reservoir on the cars fits into this valvular outlet, so that air comes from the main pipe into the reservoirs when wanted. The valvular connection is peculiar and the action is automatic. When the nozzle is put in, the air can flow; when withdrawn, the valve in the outlet closes. This is an important feature, and the details are quite ingenious. Of course other devices than this may be used, but a practical trial has demonstrated the utility of the plan adopted. It may be desirable, too, to place reservoirs at the outlets so a great volume of air may be immediately at hand to draw from, and a quick operation in replenishing the receivers affected. Air compressors may be placed at one end of the line only, or at both ends, as circumstances dictate. The air engines connect in the ordinary manner with the driving wheels on the cars.

The system of operating is as follows: The storage and supply pipe being filled with air, say at a pressure of 100 pounds per inch, the motor's receivers are filled therefrom at the depot at full pressure. On starting out as it proceeds on its trip, the air is used on the motors either at full pressure direct from the receivers or reduced to say 30 pounds by passing it through reducing valves. It is expected that the new cars can run on the Howard and Mission Street routes, where they are expected to be placed, at a pressure of 30 pounds, but this can be increased at will by means of suitable mechanism. When the conductor strikes the bell for a passenger to get on or off, the engineer stops at just where the next valve of the supply pipe is located or within a few feet thereof. These valves are placed at street crossings generally. The engineer then takes down his feeding nozzle and inserts it into the hole in the street, and connects. The air rushes through the nozzle and fills the reservoirs until the bell sounds to start, when the nozzle is taken up and replaced on its stand. The engineer need not wait to get the first few pounds of pressure, but may start with such pressure as he has obtained. In this way no unnecessary delay occurs.

The car or motor need not be required to travel over six or eight blocks, or even a less distance, where stops are frequent. The valves may be placed at crossings or even every hundred feet if necessary. It is desirable to be able to refill the receiver at every stop, to have great pressure when starting. Several suggestions have been made to operate street railroads with compressed air carried near the track, but none have included within their scope the system here proposed, which is the invention of Mr. George Pardy of this city. In this system the maximum weight of the load and contingencies of the trip do not control, but have only the effect of limiting the distance the motor will be capable of traveling without having recourse to the supply pipe, constantly at hand. In fact, those stoppages which are of necessity caused by taking or leaving passengers are the only ones necessary to make, it being calculated that these will be ample in most cases to give the required opportunity to replenish the receiver.

In running on this system they get over the great loss of power required to move a cable. On the cable roads 68 per cent of the power is necessary to drive cable alone without counting cars or passengers. Then again it is different from steam dummies or locomotives in this: there is only one central fire for the compressing machinery, instead of separate fires, boilers, etc., for each machine. They expect to utilize 50 per cent of the useful effect of the compressed air. One engine supplies all the cars. These cars are expected to go up a grade of one in fifteen.

The experimental trial of the system already made proved very satisfactory to the promoters. The car ran with 100 pounds pressure for three-quarters of a mile one trip, and seven-eighths of a mile the second trip. The car weighed about 3½ tons and the passengers 2½ tons. The highest speed attained was 16 miles per hour, and the car went up a grade of one in thirty-seven at 8 miles per hour. The connecting valve worked satisfactorily. It is probable that this system will be adopted by the Howard and Mission Street car lines.—*Min. and Sci. Press.*

Gelatino-Chloride of Silver Emulsion.

Although somewhat slower than a bromide emulsion, the chloride possesses greater scope for positive printing than can be attained with the bromide.

Mr. A. L. Henderson, of London, England, recently handed us the following formula for a chloride emulsion, which, judging from the specimen pictures, is very practical and useful:

Hard gelatine	80 grains.
Water	1½ ounces.
Nitrate of silver	75 grains.
Water	½ drachm.

The gelatine and silver are dissolved separately, then mixed, the silver solution being warmed and gently poured into the gelatine.

To this is next added (stirring the silver solution all the time):

Dry sodium chloride	21 grains.
Potassium citrate	21 "
Dissolved in water	½ drachm.

which is warmed.

The emulsion is poured into a dish and allowed to set.

The jelly-like emulsion is now cut into strips and washed in the usual way; cold water should be used, as the emulsion is very thin. The wash should be carried on under a yellow light.

After washing, the emulsion is melted by heat, and to it are added:

Salicylic acid	3 grains.
Dissolved in alcohol	2 drachms.

Also—

Chrome alum	1 grain.

Dissolved in a small quantity of warm water.

After the emulsion is filtered the plates are coated with it in the usual way. The film is extremely thin, on account of the watery composition of the emulsion. If more contrast is wanted, the emulsion should be made thicker by the addition of gelatine.

As it will not keep well, only small batches should be made at a time, enough to cover the plates to be coated.

Opal plates coated with the emulsion are printed behind a negative in a frame in the same manner as with ordinary silver paper; the picture will appear on the surface in the same way. The exposure varies with the density of the negative, and may readily be ascertained by exposing a piece of paper coated with the same emulsion behind the negative. After printing, the plate is first well washed, and is next toned with the ordinary chloride of gold and borax toning bath; it is again well washed, and fixed for 10 or 15 minutes in a hypo bath of 21 per cent strength; is washed well and soaked again for a few minutes in an alum bath, washed, and dried.

Wire Rope Transmission for Pumping.

A recent issue of the transactions of the *Societe de l'Industrie Minerale* contains the description of two small pumping plants at the Segur pit of the Montchanin colliery and the Orleans shaft of the Brassac colliery, France. Both are interesting examples of the employment of wire rope transmission for driving underground pumps by surface machinery. At the Segur shaft the hoisting engine is used for pumping at night, but, especially during sinking, additional pumping is necessary, and this is done in the following way: An engine on the surface, 130 meters (426·5 feet) from the shaft, making 40 revolutions, drives a sheave making 360 revolutions a minute, the speed of the 12 millimeter (0·47 inch) rope being 22 6 meters (71·4 feet). The duty is 0·3 cubic meter (10·6 cubic feet) of water per minute from a depth of 135 meters (442·9 feet). The pumps are two single-acting plunger pumps, 200 millimeters (7·87 inches) in diameter, and 500 millimeters (19·7 inches) stroke, making 10·8 strokes a minute, and requiring theoretically 10·5 horse power. The wire rope is kept taut by a sliding counterweight arrangement making a tension of 255 kilogrammes (562·1 pounds). The average life of the rope is 1,900 working hours, during which 34,000 cubic meters (1,200,000 cubic feet) of water are raised.

At the Orleans shaft the pumps were used to sink from a depth of 264 meters (866·2 feet) to a depth of 325 meters (1,066·3 feet). They were driven by an old horizontal 350 by 1,000 millimeter (13·8 by 39·4 inch) engine, making 60 revolutions, driving the main sheave from which the rope was conducted into the shaft to two old Letestu pumps, 200 millimeters in diameter (7·9 inches), and with 660 millimeter (26 inch) stroke. Making 16 strokes, they were capable of lifting 0 5 cubic meter (17·7 cubic feet) of water. The rope was conducted underground over three sheaves, two of them gearing down to the speed of the pumps, while the third was used for the suspension of the weight to keep the rope taut. The sheave on the surface makes 200 revolutions, and the pump sheaves 312, the speed of the rope being 20 meters (65 6 feet). One rope lasted 73 days, a second 81 days, the total length being 590 meters (1,935·8 feet) and its diameter 13 millimeters (0·51 inch). The wear of the ropes in both cases seems excessive.

Soap for Removing Stains.

It has been for long a great desideratum to obtain an article really possessing the frequently rather contradictory properties and qualities demanded of such an article. Many productions have indeed been well pushed for the purposes in question, but the effective articles are few and far between. Only too often the much vaunted "stain soap" consists of nothing else than coconut soap, and does not contain a trace of either ox gall, turpentine, or any other ingredient suitable for increasing the detergent powers of a soap. A favorite trick, according to *Moniteur de la Teinture,* employed by unscrupulous demonstrators of the efficacy of the article in which they deal, is removing a stain which they make on a piece of cotton cloth with a brush charged with gas tar. If, however, the tar used be examined, it will be found that it has been well mixed beforehand with strong acid, and so can be removed almost as well without soap.

A good stain removing soap ought always to smell rather strongly of turpentine or similar compounds. In the glove cleaning trade the quality of the soap specially prepared is of the highest importance, and much attention is paid to this article by careful operators. There is no reason whatever why a special article for removing accidental stains, which do occasionally occur in even the best managed works, should not be prepared in every bleach, dye, and print works, especially as there is often the necessary skilled chemical superintendence ready at hand in the person of the works' chemist. We give the two best formulæ known, with full directions for preparing the soap satisfactorily. Take 22 pounds of the best white soap and reduce it to thin shavings. Place it in a boiler, together with

Water	8·8 lb.
Ox gall	13·25 lb.

Cover up and allow to remain at rest all night. In the morning heat up gently, and regulate it so that the soap may dissolve without stirring. When the whole is homogeneous and flows smoothly, part of the water having been vaporized, add

Turpentine	0·55 lb.
Benzine, best clear	0·44 lb.

and mix well. While still in the state of fusion color with green ultramarine, and ammonia, pour into moulds, and stand for a few days before using. The product will be found to act admirably, and the yield is very good indeed. The second method we shall give is rather more difficult to carry out than the former one, as it requires a little skill in soap boiling to prevent the soap coming out unevenly on stirring, and the introduction of the ox gall requires to be done carefully. Take of

Coconut oil	27·5 lb.
Tallow	2·2 lb.
Soapstone (talc)	4·4 lb.
Caustic soda, sp. gr 1·349 lb	15·4 lb.
Ox gall	6 lb.
Turpentine	0·3 lb.
Benzine	0·1 lb.
Brilliant green	0 1 lb.
Ultramarine green	0·05 lb.

Melt the fat, add the stone and color, cool to 20° C., and then add the solution of soda. When all is well united and mixed, add very gradually the gall, continuing the agitation without stopping for some time after all has been added. Should any separation take place, cover the boiler up for a few seconds, and if this does not help, fire up again, and continue stirring. Lastly, add the turpentine and benzine. Pour into moulds, and stand before using. This preparation, when properly applied with a brush, will remove the most refractory stains without injury to the cloth.

Coral Fishing.

Coral fishing is largely followed in Algeria, 40,000 to 45,000 pounds of coral, valued at about £38,000, being the yearly production; La Calle is the center of this industry, and there are employed annually 160 boats and 1,300 men. The coral is obtained by means of a wooden apparatus in the shape of a cross, having in its center a leaden slug or stone for ballast. Nets, the meshes of which are loose, are hung on the bars of the cross and dragged at the bottom of the sea, and among the nooks and crevices of the rocks. These nets, winding about the coraline plant, break up or tear off its branches, which adhere to the meshes. The apparatus is drawn up by the fisherman whenever he thinks it sufficiently laden. There is also a net which is provided with large iron nails, having thus great force to break the coral, but this apparatus is forbidden to be used.

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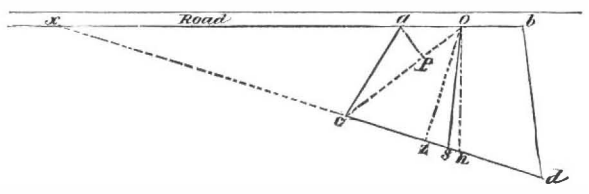
Correspondence.

Working Surveyor's Problems.

To the Editor of the Scientific American:

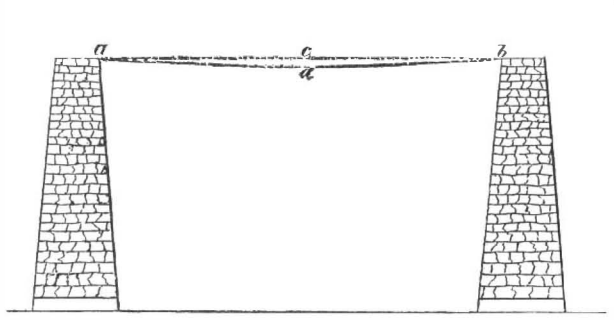
Being recently called to survey a field, the problem was to bisect a quadrilateral from a point given on one side. Robinson solves this by prolonging the sides *a b* and *c d* to their intersection at *x*, thence by similar triangles. Loomis and Davis give a "cut and try" method, as in the figure, set a trial stake at *n*, compute *c a o n*, then add or subtract by triangle. The first method goes outside the figure, and for proof by literal measurement would carry the chain over too many fields to the point *x*. To guess at a point, as by trial stake at *n*, necessitates a long computation. The method given is very simple, and would suggest itself to many minds, and yet I have not seen it published. It is a positive method without a trial stake, and does not lead outside the figure.

The circumstances were: Two men had purchased twenty acres in partnership; on dissolution, the land was divided, leaving each an equal front on the road. In *a b d c* sides, and angles at *c a b d* given, to draw a line to *c d*,



from the point *o*, bisecting the figure. Draw and compute *c o* and *a P*, let fall from *a*, perpendicular on *c o*; then compute *c a o*, and subtract it from ten acres, leaving area of *c o s*. Draw and compute *o z*, let fall from *o*, perpendicular on *c s*, then area of *c o s* divided by one-half *o z* gives *c s* and the point *s*. Join *o s*, and it will be the line which bisects *a b d c* from the point *o*.

Being called to measure accurately an air line across a chasm of 126 feet for an iron bridge, and being without a steel tape the first day, I placed two new steel squares end to end along a wooden rod for sixteen feet with a microscope, and with this measured a steel wire laid and stretched straight on a level surface of boards, then stretching the wire across from *a* to *b*. I was at a loss to know how much to allow for the shortening of the wire caused by the sagging at *d*. Returning to the level surface, I stretched and measured the wire again, marking the position of the ends on the surface. Then releasing one end and allowing the wire to hang slack, I stretched it unsupported along its course at the side of the board surface, and found that when taut, and



with a depression of two inches at the middle, the shortening was less than one-quarter of an inch for the entire length. Equal tension in stretching was tested by the pitch of the taut wire. On obtaining a 100 foot steel tape immediately by express, the steel squares and pole had given a result with a total error of less than one inch for the entire length.

On accepting the work I had asked and obtained permission for a possible error of two inches until I should obtain more accurate instruments.

I would like to hear from others on these or other similar problems. What is the method used in obtaining air line distances, as at the piers of the cantilever bridge at Niagara, and with what result? E. D. VANCE.

Kinsman, Ohio, May, 1884.

Summer Diet.

Two good rules in diet, good in summer or winter, and at all times—apparently trite, because so often repeated, but still alive and useful while men live and have stomachs—may be thus stated: Rule first is, as the *Ledger* has often repeated, "The rule of not *too much*." In the languor of summer one is tempted to the use of stimulants more or less hurtful, but all to be included under the general term of "irritants." These create a factitious appetite, which demands an oversupply of food, and leaves the eater no better off, so far as comfort is considered, than he was before eating. If you don't wish to eat, take care to eat but little, and that of the most digestible food, till the desire comes naturally. Just take enough to support nature, and good digestion will provide an appetite for the coming meal times.

Rule second is, the rule of not too *mixed*. Everybody has smiled at the story of the innocent young person to whom a seltzer powder was prescribed, and who dissolved the separate components in separate glasses and swallowed first one and then the other. Astonishment and rebellion arose in his stomach at the entrance of two such uncongenial visitors. The truth is, however, that this experiment is very often unconsciously repeated in still more unpleasant and even dangerous form. People swallow, without thinking, and often without knowing, incompatible and warring articles of food or of refreshment at the same meal, and thus turn their stomachs into chemical laboratories or fermenting tanks. Such experiments are sure to make disturbance and various internal commotions, disagreeable and perilous in their very nature. It should need no chemical analysis to tell us this; experience should be enough.—*Phil. Ledger.*

Boiler Efficiency.

When leading men speak of the steam engine wasting nine-tenths of the heat energy supplied to it, they should guard against misconception by admitting from the first that a steam engine cannot be said to waste that heat which it must give up in consequence not of its own defects, but in consequence of inherent defects in steam considered as a gas. Again, it is necessary to be more exact when dealing with this question as far as it relates to the boiler as a heat engine. The examples wherewithal to point a diatribe on the performances of a well tried apparatus should be from its best work and not from a general average, which includes the very bad performance of the indifferently constructed examples of that apparatus. For instance, it is not true that at the very outset of our operations toward the use of heat in a steam engine we throw away twice as much heat as we succeed in utilizing in the steam engine. There are what we call losses which are as inevitable as is the loss of energy due to the necessity for using, say, a lever or a wheelbarrow which has weight, because one without it does not exist, and a steam engine or a boiler works under these abstract disadvantages; they cannot be called practical disadvantages; because the practice cannot be realized under other conditions; nor theoretical disadvantages, because real theory takes into consideration all practical conditions.

We may see what a moderately good boiler does with a pound of coal. The heat of combustion of 1 pound of pure carbon burned to carbonic acid is 14,544 units, and will require for its combustion 2·666 pounds of oxygen. As we are not dealing with calorimeter experiments, we will assume that the oxygen is obtained from atmospheric air. Of this 12·2 pounds will provide the oxygen required. We shall then have 12·2+1=13·2 pounds of gases heated by the 14,544 units, and shall therefore have as the highest possible temperature with air at 60 deg., and having a specific heat of 0 238, of $T=(460+60)+\frac{14,544}{13\ 2\times 0\cdot 238}=5150$ deg. Now, if we assume that the heat of the escaping gases could be so far utilized as to fall to that of the feed water, or say 100 deg. or 560 absolute, we should then have as the greatest possible proportion of available heat, or heat which could under the most favorable and hitherto impracticable conditions be realized, only $\frac{5150-560}{5150}=0\cdot 891$; that is to say, with an absolutely perfect boiler, burning pure carbon for carbonic acid, with air at 60 deg. Fah., and only enough to provide the oxygen necessary for chemical combination, there must be a loss of 11 per cent. But this is not waste. Now to follow this up, to see how far a good steam boiler deserves the character for wastefulness which it is so common to ascribe to it, we must take more numerical values. We must make out the worst case for the boiler, and so must credit the fuel with all it possesses in the form of heat. We have supposed the air to be at 60 deg. Fah., and must take the same temperature for the 1 pound of carbon, or an absolute temperature of 520 deg. The specific heat of carbon being 0·25, it must be credited with $1\times 0\cdot 25\times 520=130$ units; the air must be credited with $12\cdot 2\times 0\cdot 238\times 520=1,485$ units, and these quantities with the heat developed in combustion = 16,159 units, from which, however, must be deducted 32 units as the equivalent of the work done in displacing atmospheric air by products of combustion raised from 60 deg. to 100 deg., at which they are supposed to escape, or increased in volume from 149·8 cubic feet to 161·3 cubic feet, which leaves us 16,127 units as the total quantity of heat available. This is sufficient to evaporate 16·69 pounds of water from and at 212 deg., but as the greatest possible quantity of the total heat realizable is 0·891, as above shown, the greatest possible evaporation from and at 212 deg. by 1 pound of carbon, the heat required to evaporate 1 pound of water at this temperature being 966 units, is $\frac{16,159\times 0\cdot 891-32}{966}=14\cdot 87$ pounds.

Now what do we get, as compared with this, from a good boiler? Following Mr. W. Anderson's excellent lecture, delivered before the Institution of Civil Engineers last December, we may refer to the results obtained in the portable engine trials made under the Royal Agricultural Society, at Cardiff, in 1872, with a portable engine boiler, nominally of 8 horse power. To begin with, the coal used was not, of course, all carbon. It was a smokeless Welsh coal, containing 0·8497 pound of carbon per pound; but it contained 0·0426 pound of hydrogen, and as the heat developed in the combustion of 1 pound of hydrogen is 4·265 times as much as by 1 pound of carbon, we have to take this into our calculation; and inasmuch as the coal also contained 0·035 pound of oxygen in combination with hydrogen, in the form of water, and will abstract its combining equivalent of hydrogen from the fuel, one-eighth of the weight of the hydrogen must be deducted. Thus, as the 14,544 units developed in the combustion of 1 pound of carbon are equivalent to 15·06 pounds of water evaporated at 212 deg., we have, for 1 pound of the above coal, the heat expressed in pounds of water evaporated

$$=15\cdot 06\left\{0\cdot 8497+4\cdot 26\left(0\cdot 0426=\frac{0\cdot 035}{8}\right)\right\}=15\cdot 24$$

pounds of water from and at 212 deg., equivalent to 14,727 units of heat.

The conditions of combustion in the furnace of a steam boiler being so different from those in a calorimeter, the quantity of air used vastly exceeds that used in the laboratory as represented by oxygen; and in the boiler we are now dealing with, 50 per cent more air was admitted than would be necessary to supply theoretically the oxygen required for perfect combustion. This makes 18 pounds—about 24 pounds is more commonly used—of air per pound of coal, and consequently 19 pounds of gases would have to be heated by the 14,727 units available, and hence the maximum temperature obtainable above that of the atmosphere would be

$$\frac{14,727}{19\times 0\cdot 238}=3,257 \text{ deg., or } 3,777 \text{ absolute.}$$

The temperature of the smoke from this boiler was 849 deg. absolute, and hence the maximum duty of the obtainable heat would be $\frac{3,777 \text{ deg.} - 849 \text{ deg.}}{3,749 \text{ deg.}}=0\cdot 7752.$

The specific heat of coal is about the same as that of gases at constant pressure, or as above given, and hence, the temperature of the air being 60 deg., the 18 pounds of air and 1 pound of coal took to the furnace 19 pounds $\times$ 520 $\times$ 0 238 = 2,350 units, which, with the heat of combustion = 14,727 units, gives a total of 17,078 units, from which must be deducted 422 units for the heat expended in displacing atmosphere, or 151 cubic feet, which leaves us, as the total available energy of the 1 pound of coal, 16,656 units. The greatest possible quantity of work to be obtained from such a boiler would, then, be

$$\frac{17,078\times\left(\frac{3,777-849}{3,777}\right)-422}{966}=13\cdot 27 \text{ pounds of water evaporated from and at 212 deg., or equal to 12,819 units.}$$

Now, the boiler actually evaporated 11·83 pounds of water per pound of coal, and hence the efficiency of this boiler was $\frac{11\cdot 83}{13\cdot 27}=0\cdot 892$, or less than 11 per cent below the greatest possible efficiency under perfect conditions.

The portable engine or locomotive type of steam boiler is thus very far from being the inefficient thing which on incomplete bases of calculation it is often said to be, and there is not after all a great deal of room for that increase in efficiency to which it is sometimes asserted we ought in some way to attain. It may certainly be said that the reproaches referred to by our correspondent are not deserved by good boilers, nor are the results obtainable by their use so very miserable. It may be necessary to remark that we are referring to good and not to cheap and bad boilers.—*The Engineer.*

A Mountain of Alum.

Mr. G. M. Shaw, of this city, has just returned from a month's trip to the Gila River country in the southwestern portion of Socorro County, where he went with Messrs. Brown and Bergen to survey and report on the recent alum discoveries there, which have been located by a company of Socorro citizens.

Mr. Shaw reports almost a solid mountain of alum over a mile square, some of the cliffs of which rise to an elevation of 700 feet above the river bed. Most of the alum is in an impure state and tasting very strongly of sulphuric acid, but of which there seems to be an inexhaustible quantity. Some of the cliffs, however, show immense quantities of almost pure marketable alum. This alum find, Mr. Shaw tells us, is on the Gila River about two miles below the fork of the Little Gila and four miles below the Gila hot springs.

Mr. Shaw reports numerous hot springs in that section, most of them gushing out of the rocks that form the river banks, some of them hot enough to cook in, and most of them too hot to hold the hand in. The main hot springs referred to above are reported to have effected wonderful rheumatic and other cures. The country is abundantly watered and wooded, and is covered with the finest of grass. The Gila is full of trout and other fish. Game, while still moderately plentiful, has been mostly scared away from the region of the hot springs by professional and other hunters, as well as ranchmen, who are beginning to locate in this difficult-to-get-at section of the Gila. At present the only way to get into this section is with pack animals over a precipitous trail of several miles, wagons having to be abandoned in the gorge of the Little Gila on the North Star Road, about two miles from the hot springs and about seven miles from the alum find, going from Socorro or from the Black range. By the way of Silver City and Georgetown wagons are abandoned on "Sapio" Creek, with about eighteen miles of pack animal trail to the hot springs.

Mr. Shaw being an amateur photographer, also, invariably carries his "outfit" along on his surveying trips, combining pleasure with business, and bringing back with him photographs of all objects and scenes of interest that he meets with on the way. He brings back from this trip over sixty photographs of the Gila country, among which are a number of exterior and interior photographs of some interesting cliff-dwellers' ruins he encountered in a cave about four miles west from the hot springs.—*Socorro Bulletin.*

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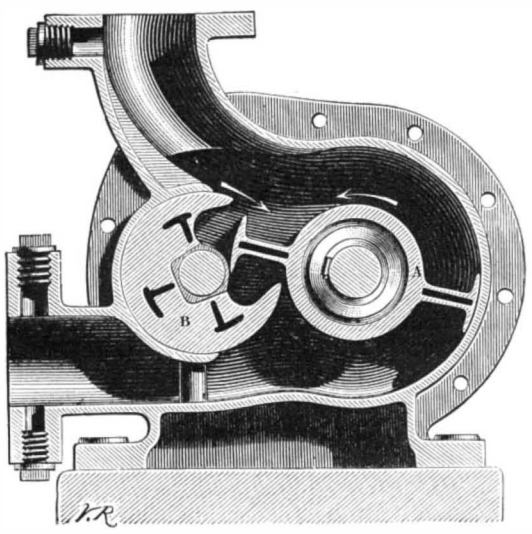
THE GREINDL PUMP.

In establishing the Greindl pump, the inventor has had in view the great excess of driving power over useful work done required by most pumps in use, arising from two principal causes:

1st. The inertia of the water, or the difficulty of putting it into motion again after it has been brought to a rest, and the consequent reduction of the effective pressure. 2d. The necessity of imparting at certain moments a high velocity to a considerable mass of water, the production of this velocity requiring the expenditure of a great amount of power, of which only a small portion is given out again as useful effect.

It is clear that if these two sources of difficulty are got rid of, a near approach is made to perfect efficiency, that is, to an equality between the theoretical driving power required and that which is utilized in the work done. Thus the invention of the Greindl pump has had its origin in carefully worked and theoretical considerations.

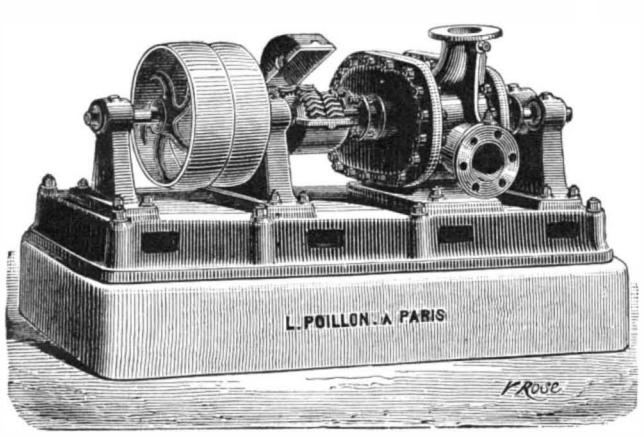
The pump consists of a chamber within which work two



THE GREINDL PUMP.

cylindrical drums, A and B, of equal diameter, running in contact with each other on parallel shafts. One of these drums, A, carries two radial vanes or blades acting as pistons, which as they revolve enter alternately into a recess of epicycloidal section extending along the whole length of the other drum, B. The shafts of the drums are geared, so that the recessed drum, B, makes two revolutions to one of the bladed drum, A, thereby enabling the single recess in the quick drum to serve for the two blades on the slower. The inlet and outlet passages are arranged in such a manner as to present everywhere the same sectional area throughout the entire course of the water, in order not to impede its movement in any way during its passage through the pump. In consequence of the continuous motion of the stream of water, any foreign solid substance can pass through the pump without occasioning either a stoppage or a breakage. The blades of the slower drum strike the water without any perceptible shock. Lateral pockets in the end cover plates afford ample space for the water to escape through at the moment when the space left between the blade and the recess threatens to be insufficient for that purpose.

As there are no springs, no leathers, and no packings of any description to cause friction, the wear is reduced to a minimum, and thereby also the driving power. The pump is, moreover, one of the simplest and least expensive to erect. The regular working speed being very moderate, the pump is not at all liable to get out of order; a pump de-



THE GREINDL PUMP.

livering 550 gallons per minute runs at only 140 revolutions per minute of the bladed drum.

Contrary to what is the case with centrifugal pumps which cannot draw air, the Greindl pump can draw gases and discharge them as effectually as liquids. It can thus in sugar refineries take the place of air pumps with valves for the boiling and evaporating apparatus, and even of carbonic acid gas blowers. It is also used to elevate molasses and juices having the consistency of paper paste, and it is fast becoming in general use in all branches of industry where a reliable pump is required.

This pump is patented in the United States, and further information will be furnished by Mr. E. Ferrand, Detroit, Mich., attorney for Mr. L. Poillon, the owner of the patents.

A Wonderful Substance.

Among the most interesting developments which have followed in the wake of the discovery of petroleum is the immense trade which has sprung up in ozokerite, or ozocerite, as Webster has it. No fairer substance ever sprang from most unpromising parentage than the snowy, pure, tasteless, opalescent wax which is evolved from the loud smelling, pitchy dregs of the petroleum still. The *Mining Review* thus sums up the many uses to which this remarkable substance is applied: This comely, impressionable article, with all its smooth, soft beauty, defies agents which can destroy the precious metals and eat up the hardest steel as water dissolves sugar. Sulphuric and other potent acids have no more effect on ozokerite than spring water. It is alike impervious to acid and to moisture. Its advent seems to have been a special dispensation in this age of electricity.

Every overhead electric light cable or underground conduit, or slender wire, cunningly wrapped with cotton thread; all these owe their fitness for conducting the subtle fluid to the presence of this wax. And in still more familiar forms let us outline the utility of this substance. Every gushing school girl who sinks her white teeth into chewing gum chews this paraffine wax. Every caramel she eats contains this wax, and is wrapped in paper saturated with the same substance. The gloss seen upon hundreds of varieties of confectionery is due to the presence of this ingredient of petroleum, used to give the articles a certain consistency, as the laundress uses starch. So that a product taken from the dirtiest, worst-smelling of tars finds its way to the millionaire's mansion, an honored servitor. It aids to make possible the electric radiance that floods his rooms; or, in the form of wax candles, sheds a softer luster over the scene. It polishes the floor for the feet of his guests, and it melts in their mouths in the costliest candies. For the insulation of electric wire, paraffine wax has to-day no successful rival, and the growth of the demand for this purpose keeps pace with the marvelous growth of the electric lighting system. A single Chicago firm buys paraffine wax by the car load. Its price is but half that of beeswax, and yet the older wax yields readily to sulphuric or other acid, this being a test for the presence of beeswax in paraffine. The demand for paraffine for candles as yet heads the list.

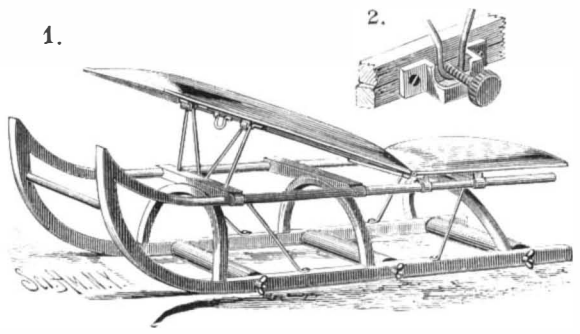
Then comes the needs of the paper consumers. In 1877 a single firm in New York handled 14,000 reams of waxed paper. Not only for wrapping candy is this paper valuable, but fine cutlery, hardware, etc., incased in waxed paper is safe from the encroachment of rust or dampness. Fish and butter and a score of other articles are also thus wrapped, and there seems literally no end to the uses found for the paper saturated with this pure hydrocarbon. In the chemist's laboratory it is invaluable as a coating for articles exposed to all manner of powerful dissolvents; brewers find it a capital thing for coating the interior of barrels, and the maker of wax flowers simulates nature in sheets of paraffine. And yet, until Drake drilled his oil well in 1859, the existence in this country of this boon to civilization was unsuspected, and it lay in the depths of Pennsylvania rocks, where thousands, possibly millions, of years ago it was stored by the hand of an all wise Creator.

Marvelous Horsemanship.

A St. Petersburg correspondent, writing to the London *Standard*, says: "This morning I witnessed a wonderful display of horsemanship. It took place in the Petroffsky Park. Here, in the presence of the Grand Duke Nicholas, and most of the foreign officers and guests, the regiment of Cossack Guards went through an extraordinary series of exercises which threw the most daring feats of the circus into the shade. The entire regiment passed at full galop, in loose order, with many of the men standing upright in their saddles, others upon their heads with legs in the air, many leaping upon the ground and then into the saddle again at full speed, some springing over their horse's heads and picking up stones from the ground, and yet regaining their seat. While performing these feats all were brandishing their sabers and firing pistols, throwing their carbines into the air and catching them again, and yelling like maniacs. Some men went past in pairs, standing with a leg on each other's horses—one wild fellow carried off another dressed as a woman. The effect of the scene was absolutely bewildering, and it seemed as if the whole regiment had gone mad. Upon a signal being given, the regiment divided into two parts. One rode off; then halted and made their horses lie down on the ground lie beside them, waiting as in war the approach of the enemy. The other section of the regiment then charged down, and in an instant every horse was on his feet, every rider in his saddle, and with a wild yell they rode at their supposed enemy. When the maneuvers were over, the regiment rode past, singing, and uncommonly well together, a military chorus. Altogether, it was a marvelous exhibition of daring horsemanship, and one hardly knew whether to admire the docility and mettle of the steeds or the skill and courage of the riders. All the foreign officers and guests were no less astonished than delighted."

A NOVEL SLED.

The rear section of the seat is fixed to the sled and is about one-third of the total length, while the forward section is hinged to the front edge of the rear one. To the under side of the forward section is pivoted an M-shaped brace, at the V-shaped portion of which is formed an eye. In front of the brace and projecting from the bottom is a loop. On the rear side of the front crossbar of the sled is fastened a clip, which holds a screw. Rollers, fitting between the runners, are mounted loosely on rods that are held in place by winged nuts screwed on the ends. As the movable section folds down, the brace folds against its under side and the loop passes between the clip and the crossbar, being held in place by the screw. When the section is raised, as shown in Fig. 1—the end bars of the brace resting upon the crossbar and the eye being held in the clip by the screw—the sled is less dangerous and more convenient than the common ones. The rollers can be easily removed and replaced; but when so provided the sled can be used indoors, on sidewalks, etc. This invention has been patented by Mr. Antonio Carra-



CARRARA'S NOVEL SLED.

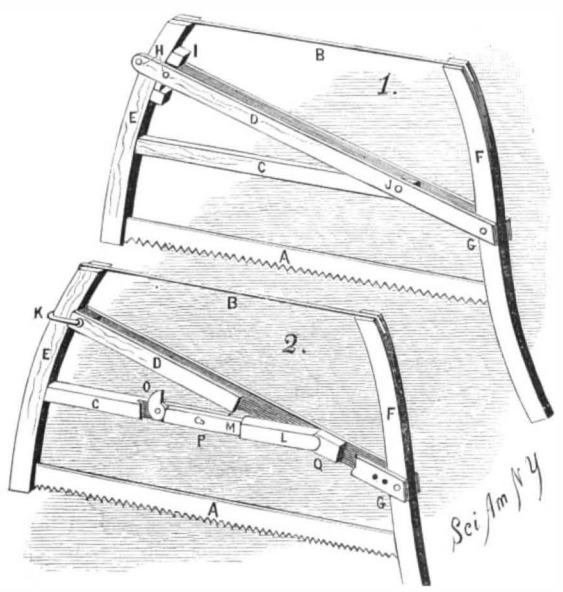
ra, and further particulars may be obtained by addressing Mr. A. Girardot, of 35 East Kinney Street, Newark, N. J.

The Blowing Adder.

The snake known as the blowing adder was formerly common in the meadows of Orange County, N. Y., but is now very rare. It is a beautifully marked snake, growing to three feet in length, and receives its name from its habit of laying its head close to the ground when disturbed and rapidly inflating or spreading it out until the head becomes twice its usual size, when the air is blown out of the snake's mouth with a noise like escaping steam. The snake is said to be poisonous. The first one that has been seen in the county for a long time was discovered by George Springstead, on July 20 in the town of Wawayanda. He smashed its head with a club, when he was surprised to see a young snake crawl out of the dead one's mouth. He cut the old snake open and found 75 young ones, four inches long, inside of it and killed them.

IMPROVED BUCK SAW.

In an invention lately patented by Mr. Myron Case, of Kasoag, N. Y., there is arranged, in place of the usual middle bar, a combined brace and strainer consisting of a thrust bar, C (Fig. 1), pivoted, near its end, to the lever bar, D, which is pivoted to the end bar, F, and extended diagonally to the upper end of the end bar, E, with which it is connected by a suitable binding device, so as to be shifted along and secured at any point. The bar, D, consists of two parallel parts provided with a connecting pin each side of the bar, E, a wedge, I, to hold the bar in any position, being placed between the end bar and pin, H. The bar may be secured by a grip yoke, K, Fig. 2. To take



CASE'S IMPROVED BUCK SAW.

up the slack the bar, C, may be made extensible, with a cam, O, pivoted on one part and bearing against a shoulder on the other part, so that the bar may be extended readily at any time by shifting the cam a little. The cam is set in a slot in one of the sections of the bar, in which slot a bar, M, is located with one end against the face of the cam, the other end being connected with a pin, P, extending through slots in the sides of the other section.

Between the two parts of the bar, D, is held a block, Q, formed with a concave shoulder in which the bar, L, rests. The bar, D, may have a series of holes for shifting the pivot pin, J, along it.

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FIFTY HORSE POWER ENGINE AND BOILER.

We illustrate from the *Engineer* a semi-fixed engine of unusually large size made by Messrs. Ruston & Proctor, of Lincoln, to the following specification:

Cylinders.—To be respectively 14 inches diameter for the high pressure and 22½ inches diameter for the low pressure, the steam passing from the first to the second, and thus expanding to the most economical extent; both to be 24 inches stroke. The working barrel of each to be cast separately of specially selected hard metal and forced into the main casting, the space between forming the steam jacket, which completely surrounds each cylinder. The slide valves of the same kind of iron scraped up fairly with the valve faces. The steam chests to be placed on each side and the stop valve chamber centrally in front, all the valves being at once accessible on the removal of their respective covers. The cylinders to be planed to receive the channel iron frame and strongly bolted to it; at the top to be secured by a flange to the boiler. The cylinder covers to be polished, the glands all brass of extra strong pattern, suitable drain and tallow cocks to be provided, and a special arrangement for draining the steam jackets. The barrels to be covered with felt and wood lagging, and finished with neat sheet iron casing fastened by screws.

Pistons.—Of improved pattern, with two metallic packing rings and internal spring ring, to be bored taper and secured by nuts to steel piston rods.

Crossheads.—Of hammered scrap iron, forged solid, tool finished all over, and cottered firmly to piston rods.

Slide bars.—To be quadruple, of rectangular section, bolted respectively to the cylinder covers and neat guide stands. Slide blocks of cast iron with large wearing surfaces. Gudgeons of steel, firmly keyed to crossheads.

Connecting rods.—Of best scrap iron finished bright, fitted at both ends with extra long gun metal bushes secured by straps and cotters.

Eccentric straps.—Of gun metal polished, with bright wrought iron rods and case-hardened joints and pins. Valve spindles of steel, to work in suitable brass guides.

Automatic gear.—The admission of steam to the high pressure cylinder to be automatically varied by the governor from 1 per cent up to 50 per cent of the stroke, according to the power required, by an improved arrangement of gear consisting of a double-ported expansion valve connected by a radius rod to a rocking slot link driven by a separate eccentric.

Governor.—Of improved cross-arm type, very sensitive in action, connected directly to the expansion gear, and furnished with an oil cylinder to steady it.

Feed pump.—Of ample size worked by separate eccentric, with gun metal plunger, valve box and valves and copper delivery pipe; to work continuously, water not required by the boiler being returned through a regulating cock to the feed tank.

Water heater.—Of improved construction, to consist of a branch from the exhaust pipe connected by a copper tube, furnished with brass cock, to the "return" pipe of the pump. The overflow water, thus highly heated by the exhaust steam condensing and uniting with it, passes down and raises the temperature of all the water in the feed tank to nearly boiling point.

Crank shaft.—Of steel bent from a single bar, and truly turned, to be long enough to carry a pulley at both ends.

Crank shaft carriages.—To be strongly attached to the frame, and very substantial, with extra long gun metal bearings adjustable both vertically and horizontally, and caps made to fit over projections on the horn blocks.

Flywheel.—10 feet diameter by 16 inches face, of heavy pattern, turned to carry belt; revolutions per minute, 90.

Bed plate.—To be formed of two strong channel iron bars firmly braced together at the ends by the cylinder and ash-pan castings, and stayed between by the wrought iron plate carrying the guide stands.

Boiler.—Placed over the engine; to be of the loco-multitubular type, very strong, of ample capacity and extra heating surface, suitable for burning wood. The barrel plates to be of best Staffordshire quality; double riveted in longitudinal seams, and arch plate of same quality. The tube plate and other plates of flanging quality.

Fire box.—To have large grate area. All the plates—front cover and tube plate—to be exclusively of Lowmoor or of Bowling iron, and to be well strengthened by deep girders and screw stays at top and sides respectively.

Tubes.—To be of best wrought iron lap welded, 2 inches extreme diameter, 144 in number; expanded by patent tool at smoke box ends, and secured in the fire box by steel ferrules.

Manhole.—To be formed in a stout wrought iron plate, flanged and riveted round the opening, with a strong cover, crossbars, and bolts. Mudholes, suitably furnished, to be made at each corner of fire box, in the smoke box, and in a mud collector placed under the barrel.

Seatings.—Strong cast iron seatings, truly faced, to be riveted on the shell to carry the safety valves and check valve.

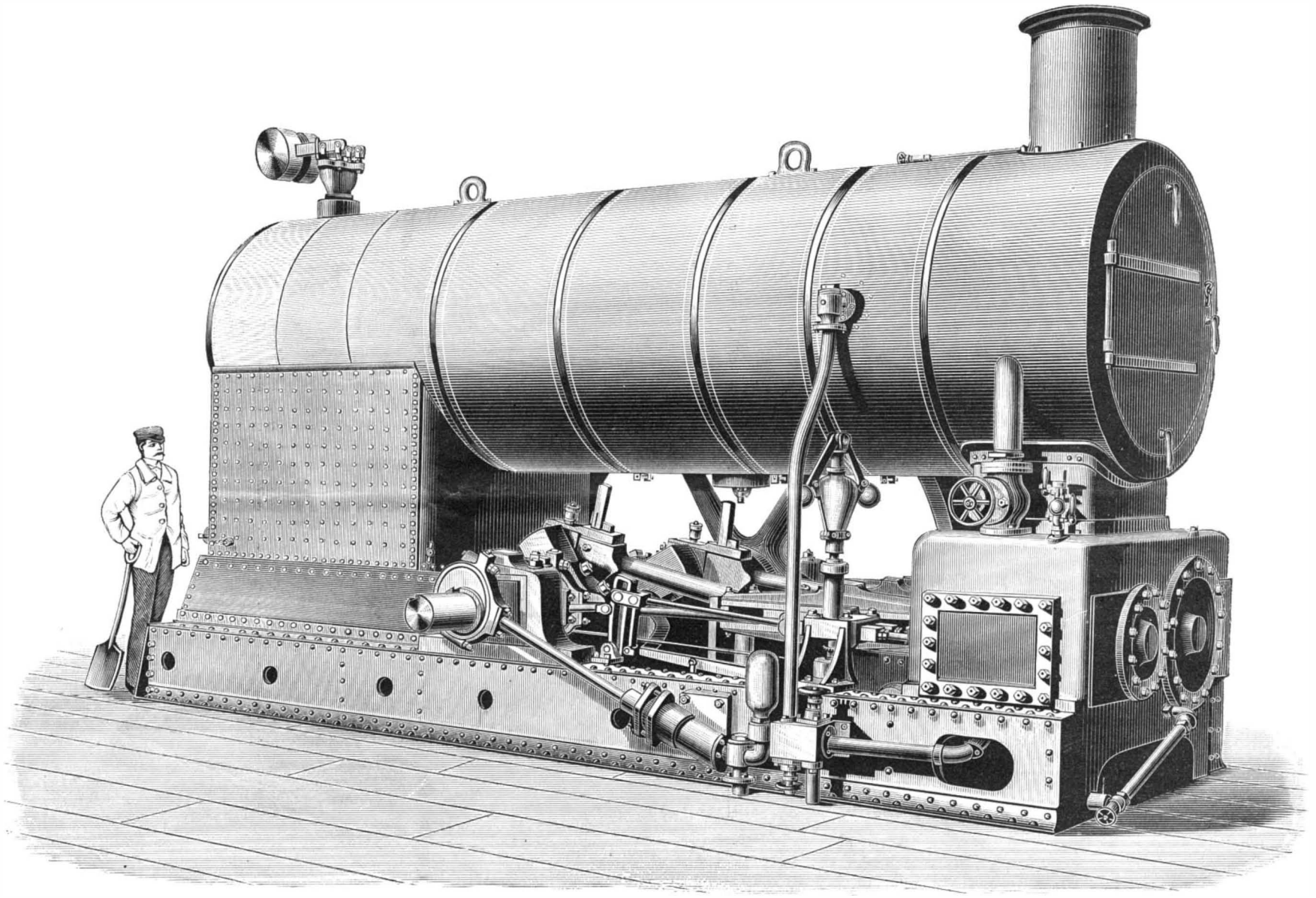
Workmanship.—The plate edges to be planed and fullered, rivet holes to be accurately punched fair with each other, and plates be riveted up by patent hydraulic machinery. The stayholes in the firebox to be drilled through both plates at once, so as to be perfectly true.

Pressure.—To be strongly stayed for a working pressure of 120 pounds per square inch, and tested by water to 200 pounds per square inch.

Mountings.—To be furnished as follows: Strong wrought iron smoke box, with door and fittings. Chimney base, and wrought iron chimney finished with bell top and damper plate. Fire door with baffle plate, set of fire bars, and cast iron ash pan with regulating damper. Brass safety plug screwed into crown of fire box. Balanced steam stop valve with starting handle, placed in the cylinder casting, and connected by a copper bend with an anti-priming pipe fixed inside the boiler. Combined spring balance lever safety valve, and improved lock-up spring safety valve. Steam pressure gauge and brass siphon, glass water gauge of strong pattern, two brass gauge cocks, and signal whistle. Steam jet pipe and cock for forcing the draught. Brass blow-off cock and water plug.

Sundries.—The boiler barrel to be felted, lagged with wood, and neatly covered with sheet iron. The engine to have good lubricators to all bearings; tool box and set of case-hardened spanners; firing tools and shovel; suction and return pipes; tube brush and rod; water funnel; oil tin and spare gauge glass; also suitable holding-down bolts.

Generally.—To be capable of working up to three times its nominal power, and to be tested under steam by a friction brake; to be made throughout of the very best material and workmanship, every part being finished accurately to gauge by the most modern appliances.



FIFTY HORSE POWER COMPOUND ENGINE AND BOILER.

Coal Dust Fuel in France.

The United States Commercial Agent at Nantes says that the coal dust, which was formerly rejected as worthless, is now consumed in immense quantities in France in the form of "patent fuel," or coal bricks. The natural supply of dust from the yards of the coal merchants being entirely insufficient for the needs of the brick works, the manufacturers, particularly in the Nantes district, import a large quantity of coal dust from Cardiff, Swansea, and Newport. The process of manufacture is very simple. The coal dust is mixed with pitch, and the mixture poured into cups attached to a belt, each cup containing just enough material for a brick of the size desired. The belt in its movement passes this material through a chamber where it is exposed to steam, which fuses the two substances into a homogeneous mass.

This is poured by the descent of the belt into moulds, where it is subjected to an enormous pressure by a hydraulic press or by machinery set in motion by a steam engine. The brick is square in form, its thickness being about one-third of its other dimensions, and it weighs five, ten, or fifteen pounds. Certain of the French railway companies refuse to accept fuel unless at least 10 per cent of pitch has been used for its agglomeration. It is stated that *briquettes* are preferable to ordinary coal for exportation to the colonies and to warm climates on account of their compact storage and freedom from small fragments and dust, also for use on locomotives, both on account of economy of space and because firemen can always determine the amount of fuel they are employing in a given time, the weight of each brick being exactly known. The manufacturers claim that the "patent fuel" is more healthy for domestic use than ordinary coal, citing in support of this theory the declaration of certain well known physicians. At the present day a large number of bricks are made for domestic use, of small size, and perforated with circular or longitudinal openings.

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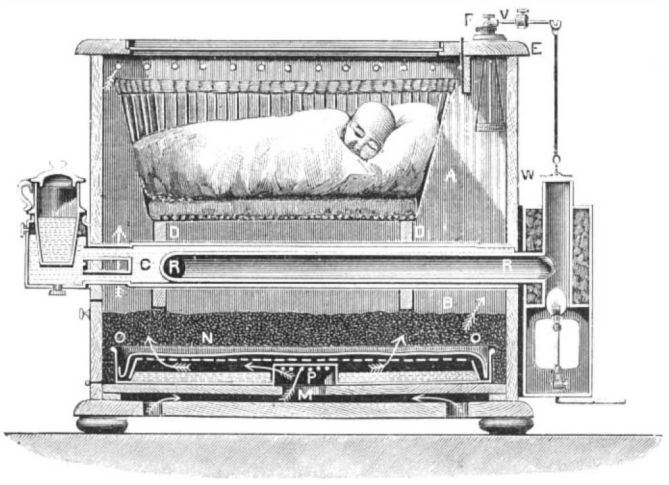
A NURSE THAT WILL NEVER BE CARELESS.

An English inventor has patented what is described as a "thermostatic nurse." Nursemaids may think this a rather high sounding name, and possibly some will feel it an imputation on their class, but the title very well expresses the character of the invention. It is an artificially warmed and thoroughly ventilated box, in which a crib or hamper with a baby in it can be kept at an even temperature, varying only about one degree from the standard decided upon, the air being slightly moistened, and a glass cover permitting all the personal watchfulness that may be desired.

The device is shown in the accompanying engraving, the case being of wood, divided horizontally into upper and lower compartments, A and B, by a shallow inclosed tank of water, C. Above the water tank, and supported on slips of wood, D D, is a cradle for the reception of the infant, which lies under a glass window, E, hinged at the back, and connected with a lever plate, F, the latter also connecting with a thermometer and an alarm bell. Through the hole, M, at the bottom fresh air is regularly admitted, passing through a cap, P, and two layers of coarse canvas, N, the latter dipping into a metal water tray, O, to keep the canvas through which the air passes always moist. To the right is a gas flame, the heat from which passes through a flue, R R, shaped like the letter U, so as to twice traverse the length of the water tank, to heat the water. For the regulation of the temperature a metallic capsule, S, containing a liquid which boils at 90°, is fixed near the head of the cradle, and connected with a light lever, V, pivoted to the lever plate, F. From the free end of this lever hangs a little damper, W, which regulates the heat to be supplied by the gas flame or lamp. If a higher or lower temperature be desired, the device can easily be adjusted therefor. This apparatus differs from the French device for a similar purpose, which was fully described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 434, in that the regulation of the temperature here is entirely automatic. The use of this "thermostatic nurse" and the so-called French "baby incubator" of Dr. Tarnier has been highly recommended by hospital managers, as conducing largely to the saving of life among infants that must be raised in public institutions. Perfect ventilation and even temperature are especially important for infants of low vitality, and by means of such apparatus it is said that in 145 cases at a Paris hospital, where the infants weighed at their birth only about four pounds, the average mortality was reduced from 66 to 38 per cent.



THE THERMOSTATIC NURSE.

POST MORTEM ATTITUDES.

Dr. Brown-Sequard has recently published an interesting paper* upon the post mortem preservation of the attitude that the subject presented at the very moment life ceased. In giving these facts the principal object of the author was to seek the cause of the phenomenon; but he arrived at the conclusion that a solution of the question cannot be reached in the present state of science.

If this delicate problem embarrasses the learned physiologist, I certainly have not the pretension to offer in this place a satisfactory solution. My only object is to point out a few facts of a special nature that Dr. Brown-Sequard did not allude to. As these are capable of throwing light upon certain points of the question, and of thus helping its solution, I have thought it worth while to make them known.

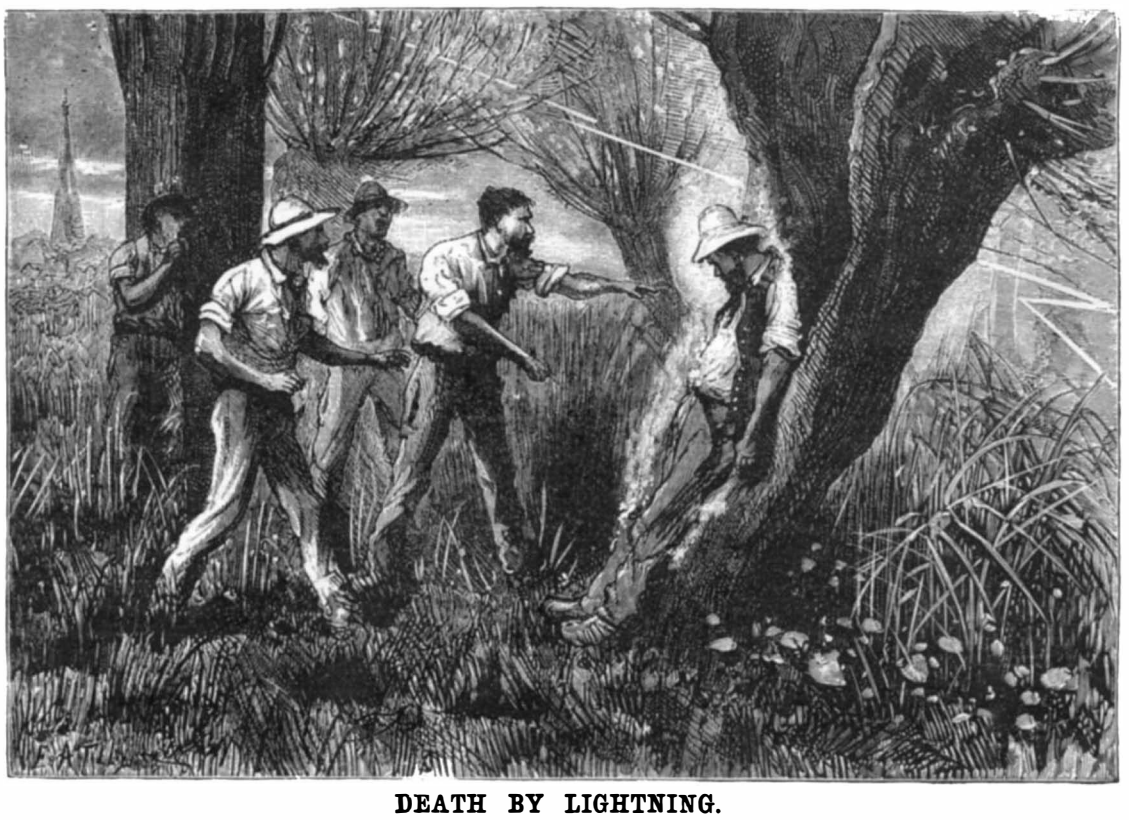
In order that this phenomenon of the preservation of the last attitude may manifest itself, a few peculiar conditions are necessary, the principal of which appears to be a violent, instantaneous, or quick death. But such a condition very often occurs without a preservation of the attitude being observed; and, on another hand, cases are likewise cited where death seems not to have been instantaneous, nor even very quick (relatively at least), such as the case of a wound in the thigh. There has also been invoked, as an active cause, the moral influence exerted upon the subject in cases where death was not instantaneous, or at least in those in which the subject has had a knowledge or quick perception of the danger that menaced him. Without any explanation of the immediate cause—the starting point of this instantaneous action of the nervous system—the thing itself has been designated as *sideration*. Now, in pointing out the causes of death that have given rise to a preservation of the attitude, Dr. Brown-Sequard has omitted to mention the cases in which this expression of *sideration* can be applied in all its fullness, properly and not figuratively, and that is in those cases in which death has been caused by lightning.

Such cases are quite numerous, and some details have been ascertained that may throw a light upon the question. I shall, in the first place, cite the most remarkable observations.

1. One of the oldest facts is related by J. B. Cardan, who published a work upon lightning at Lyons, in 1633. Eight farm hands had taken refuge under an oak, in order to protect themselves from a storm, and to eat their lunch. A peal of thunder was heard, and the eight persons, struck dead by lightning, remained in the position that they were occupying. One of them was holding a glass, and another was putting some bread into his mouth, without any modification of the facial expression having occurred.

2. The preceding fact left some doubts, and there has been a disposition to believe it an exaggeration, but another and identical one was afterward reported by a Protestant pastor, Butler, who was a witness of it. On the 27th of July, 1691, at Everdon, ten harvestmen took refuge under a hedge upon the approach of a storm. Soon afterward a thunderbolt fell and killed four of them, who remained immovable, and as if petrified, in the very attitude that they had at the time. One was holding between his fingers the pinch of snuff that he was about taking. Another was holding on his knees a dead dog which he was caressing with one hand and offering a piece of bread to with the other. A third was sitting with his eyes wide open and his head turned in the direction of the storm.

3. Abbe Richard relates that the proctor of the Seminary of Troyes was returning upon horseback, when he was struck by lightning. A brother, who was following him, not having perceived it, thought he was asleep because he saw him tottering. Upon trying to awaken him he was found to be dead.



DEATH BY LIGHTNING.

4. Another and analogous case is likewise related in the funereal annals of lightning. A priest was struck while upon horseback, without the animal being injured. The latter continued his accustomed route, and reached home with the dead horseman, who still preserved his attitude. The distance thus traversed was about two leagues.

5. On the 9th of May, 1781, at about three o'clock, the lightning struck the door of the chapel of the Commandery of St. John, near which a woman and three children had taken refuge. The woman, who was seated in front, was suffocated without changing attitude, as was also one of the children.

6. On the 14th of August, 1793, a man, surprised by a storm in the environs of Dover, took refuge with four horses in a thicket. A thunderbolt having fallen, the four horses and the man were killed, with the peculiarity that the latter remained seated.

7. On Sunday, July 11, 1819, the church of Chateauneuf (Lower Alps) was struck by lightning during divine service. A large number of persons was struck (82 wounded and 9 killed). The peculiarity to be pointed out is that all the dogs that were in the church were found dead in the attitudes that they previously had.

8. At Vic-sur-Aisne in 1838, three soldiers, in the midst of a violent storm, took shelter under a linden, when, by the same stroke of lightning, all were instantaneously killed. Moreover, all three remained standing in their original position, just as if the electric fluid had not touched them. Their clothing was intact. After the storm, some passers-by who saw them, having spoken to them without getting any answer, approached and touched them, when they all fell into a heap of ashes.

9. In the month of July, 1845, four inhabitants of Heilz-le-Maurupt, near Vitry-le-Francois, took refuge, three of them under a poplar and one of them under a willow. Soon afterward, the one who was under the willow, and leaning against it, was struck by lightning. A bright flame was issuing from his clothing, but he did not appear to see it. "You are burning! Don't you see that you are burning?" cried his companions (see engraving). Upon running to him they found he was a corpse.

10. An animal forms the subject of this observation, which was made after a winter storm, in January, near Clermont. A goat was struck by lightning and immediately killed. It was found standing upon its hind legs still holding a green branch in its mouth.

11. A young woman, the wife of a miner of Ricamarie, had gone to visit her family at Saint Romain-les-Atheux, taking with her her four months old child. It was on July 16, 1866, and she was alone in the house during a storm. When her parents returned from the field a sad spectacle awaited them, for the young woman had been killed by lightning. She was found on her knees in a corner of the room, with her face concealed in her hands. She bore no trace of a wound. The child, which was lying on the bed in the room, had been but slightly touched by the electric fluid.

12. I have related the preceding observations in chronological order, but I terminate with one, nevertheless, that should have come first. It is narrated by Quintus Curtius (lib. viii., cap. iv.). Alexander the Great was traversing Asia and spreading ruin on his way. When he reached the region now called Bokhara, his army was assailed by a frightful cyclone. This terrible tempest carried off nearly a thousand men—soldiers, sutlers, or valets. It is said that some of these were found leaning against the trunks of trees, and seeming to be still alive and talking with each other, in the same situation in which death had overtaken them.

The observations which precede seem to us to furnish some useful information in regard to some points of the question. Thus a perception of danger is not necessary to explain the influence exerted upon the subject. The case of the soldier observed at Beaumont, near Sedan, seems to be demonstrative. He was not conscious of danger, by reason of the quick and unforeseen action of the bullet. This cause most certainly cannot be invoked in case of death through lightning. It is perfectly demonstrated by numerous observations that the subjects thus struck have not and cannot have any apprehension of their imminent danger. The person who is struck by lightning not only does not hear the noise of the thunder, the propagation of which is relatively slow, but he has not even any perception, any warning, of the flash, whose rapidity is proverbial. Death is instantaneous, and the subject has not experienced the moral influence that results from a perception of danger. We have particularly related the cases that comprise animals (obs. 7 and 10). These could not have had any such apprehension. It is remarkable to see that *all* the dogs were struck, and that all preserved their attitude in the occurrence at Chateauneuf, while the number of human victims was proportionally much less. None of these latter, moreover, preserved the attitude that he had at the moment of death. In obs. 6 a man preserves his position and remains seated near four dead horses that did not maintain *their* attitude. In obs. 1 we see that *all* the individuals exposed to the action were killed, and *all* (to the number of eight) preserved their attitude. In the second case four out of ten were struck, and the six others do not appear to have been influenced by

* SCIENTIFIC AMERICAN, page 23, ante.

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the electric fluid. In short, all those that were struck dead preserved the last attitude of life.

Cases of lightning stroke are unfortunately quite numerous, but the number of those in which a preservation of the attitude has been observed is relatively limited. Although there are no comparative figures upon which an exact proportion can be established with certainty, it nevertheless appears that they are more frequent after lightning stroke than after other modes of sudden death.

Let us further remark that in cases of death by lightning, with a preservation of the attitude, it has been found that no external lesion exists (obs. 11) upon the body of the victim, and no autopsy has shown what point was thus influenced without any apparent contact. Perhaps no peculiar alteration could have been found in the essential organs of life; and it is especially in such cases that we may employ the expression *sideration* in all its acceptations.

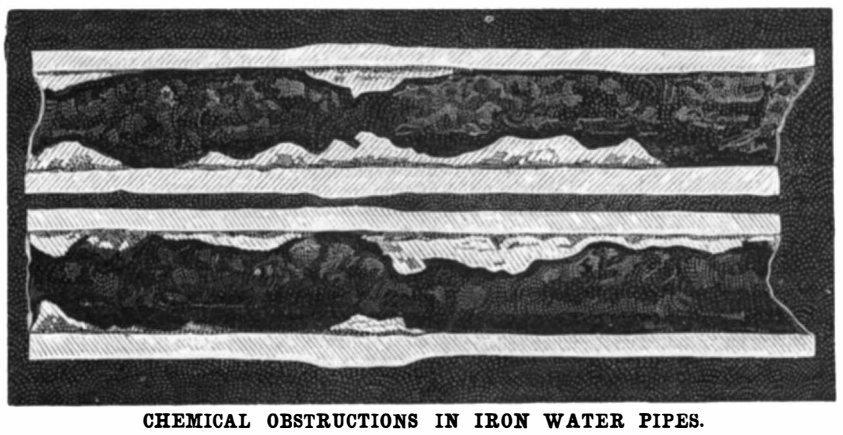
The peculiar circumstances that accompany death by lightning may acquire (as they have done) a certain importance from a medico-legal point of view. But I have not to concern myself with that here, my only object having been to point out a few interesting facts, whence we may draw some useful data for the study and solution of this question of post mortem preservation of the last attitude of life.—*Dr. J. Rouyer, in La Nature.*

Manufacture of Soda.

The Leblanc process of manufacturing soda is carried on at the works of the Newcastle Chemical Company, which have been in operation 50 years, and are so extensive as to cover more than 60 acres of ground. Some idea of the magnitude of the operations of this company is conveyed by the fact that they manufacture upward of 60,000 tons of products per annum, comprising soda ash, soda crystals, refined soda, and bleaching powder. A large number of auxiliary processes are included, such as repairing shops, fire brick works, gas works, and a very extensive cooperage, capable of turning out 1,000 casks per day. Several of Wilson's gas producers have been erected at these works, and yield satisfactory results. The following is an outline of the processes carried on: Sulphuric acid is produced from pyrites smalls (which contain about 50 per cent of sulphur) in the usual lead chambers. The sulphuric acid is used for decomposing common salt; thus producing hydrochloric acid and sulphate of soda. The latter is mixed with a proportion of limestone and small coal, and fluxed into a uniform mass in large revolving cylinders; thus producing "black ash." The liquor obtained by lixiviation of this black ash with water is a solution of carbonate of soda, which is obtained in the dry form by evaporation. This is further refined by resolution, and allowing all soluble impurities to settle out; and the refined liquor when evaporated yields ordinary washing soda. The hydrochloric acid is collected by passing the gas into towers supplied with water, similar to gas works scrubbers, and packed with brickbats. It is used for the manufacture of chloride of lime (bleaching powder).

CHEMICAL OBSTRUCTIONS IN IRON WATER PIPES.

We take the following illustration and notes from a paper read by Col. Wm. Ludlow before the Engineers' Club of Philadelphia. The illustration is of a specimen of water pipe which had been taken up for the improvement of the water supply to certain dwellings in Philadelphia. It is of two inch pipe, about twelve inches long, and had been in the ground twelve to fourteen years, connecting the main in the street with the house fixtures. Upon testing the water pressures with a gauge, it was found that the hydrant in front of the house had a pressure of seventeen pounds, which was reduced in the kitchen of the house to seven pounds, the difference clearly indicating an obstruction in the service pipe. The pipe having been taken up, a piece was sawed longitudinally, when the interior was found to be nearly filled with a deposit composed of the sesquioxide of iron and sedimentary matters, the tortuous channel through the pipe being constricted at several points to about three-eighths of an inch. Another piece of obstructed pipe, originally three inches, which had been in the ground over thirty years, had become almost entirely closed from the same cause.

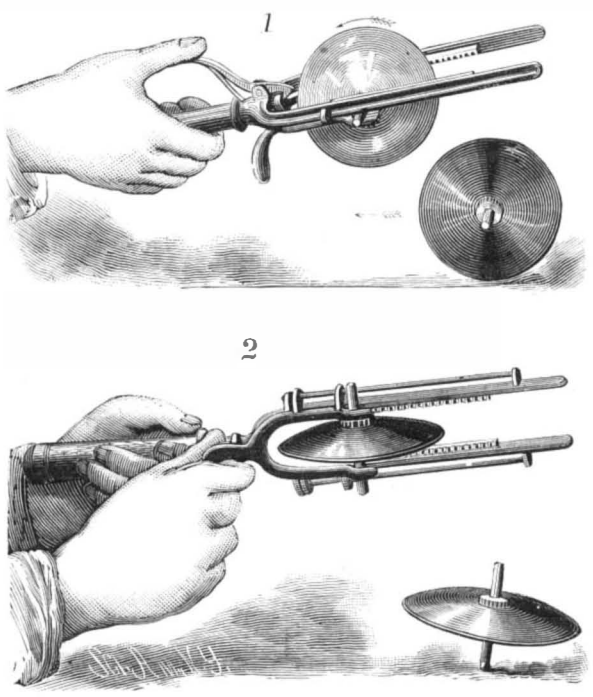


CHEMICAL OBSTRUCTIONS IN IRON WATER PIPES.

'Discoveries of this kind are constantly being made, and pipe that has been in the ground over ten or twelve years cannot be depended upon to convey its full volume. Two methods of obviating this difficulty other than galvanizing, which was not considered advisable for a supply of water for drinking purposes, were known. The one in use by the department (Philadelphia) for its large mains, namely, coating the pipe when newly made with a coal tar pitch prepared and supplied in accordance with certain specifications, apparently protected the pipe for a period of from twenty-five to thirty years. This, however, would be less advantageous in the case of small service pipes, for the reason that it decreased in a considerable proportion the available diameter. The other method was a process known as the 'Bower Barff,' which consisted in coating the pipe with a film of magnetic oxide produced by subjecting the iron to the action of superheated steam or air under certain conditions. This process promised good results."

A NOVEL TOY.

The construction and manner of using this interesting toy are very clearly shown in the accompanying engraving. In the handle of the toy, shown in the upper view, is a spring which is compressed by a rod upon whose outer end is a carrier moving in parallel guide bars whose inner sides are formed with racks, in which engages a pinion on the spindle of the top. The carrier is held in place by a spring catch. In the second view the spring is done away with, the carrier being moved by hand. When the carrier is released—the instrument being held with the trigger toward the right hand—the top will be thrown from ten to twenty feet away and will spin upon its spindle; when held with the trigger toward the left hand, the top will describe a curve in a contrary direction. When the trigger is held upward, as shown in Fig. 1, the top will run away to a distance of about twenty feet, stand still an instant, and then return; but when the position of the toy is reversed, the top will roll away from three to four hundred feet, according to the ground.



VOLKE'S NOVEL TOY.

This invention has been patented by Mr. C. A. Volke, of 53 Canal Street, Stapleton, Staten Island, N. Y., who may be addressed for further particulars.

Small Inventions.

We have had it in mind for a very long time, says the *American Inventor*, to obtain some solution to the question: What are "small inventions"? This and the kindred phrase, "mere mechanical skill," are matters that puzzle us. They constitute the great and annoying unguessed riddles of the present day. We know that the law has not intimated, so much as by expression or impression, that there is to be any scale in estimating the degree of novelty in any given device or process. It seems to be the intent of the law that any improvement, so long as it is a tangible one and expressible in words and by claim or claims, is to have favorable consideration.

But later students in this time of reason and judgment have, as we are informed, come to the sagacious conclusion that too many patents on small inventions are granted, and so the ruling of the Patent Office has been tending somewhat of late, as it appears to us, to establish a policy of exclusion based on the merely chimerical hypotheses suggested above.

We do not say that there never has arisen, or never will arise, an instance where an invention is so merely seeming and not substantial as to lack the real merit of an advance, or that sometimes a so-called invention may not be simply the result of a workman's skill. We grant that very unfrequently such an instance may arise, possibly once where the assertion of the one or the other change is made a hundred times.

But we do allege that the law supposes, takes it for granted, admits, assumes, that an improvement is an advance, and so says it shall be patented. Who so good a judge of the real worth and value of one of this kind of inventions as the man who at the work bench, in the factory, on the farm, or in some other hard, prosaic, and rough school, having solved the problem and made the improvement, pays the costs and charges of obtaining the patent, and is willing to bear all the risk of making anything out of the patent? The mere possession of his letters patent confers no power on the patentee to work havoc on an innocent public. The courts are open to all to show that the improvement is not good, and equally open to the patentee to prove his case. No small boon this last.

At the recent Cincinnati Convention one of the inventors in attendance told us a tale which disproves scores of the fine spun decisions of the Patent Office on the grounds named above. This party a few years ago was as poor as poverty, had a large family, was blind in one eye, had no friends to help him, and was about to call his game of life a dead loss to all interested. One day, while fixing up, as best he could, the miserable apology for a rail fence that inclosed the few thin and worn mortgaged acres about his home, he hit on a plan of saving one rail in each panel. It was a revelation to him, so he jobbed out around the country, mending his neighbors' fences on this saving plan. After a while and by exertions, the narrative of which would moisten any hearer's eye, he scraped enough money together to enable him to apply for a patent. As a matter of course, in those days his case was rejected over and over by the examiner. Finally he appealed, and by good luck got the ghost of a claim. In a few months, by sales of patent rights, he had paid the large costs and interests on the money borrowed to get the patent, and cleared some three thousand dollars besides. This patent was simply a starter, for he invented many improvements in fencing, farm gates, etc., till now he has more than a dozen patents. He is said to be worth upward of $30,000 to-day, and to be held in great esteem by his neighbors as a driving, steady, honest business man.

We do not intend to convey the impression that every so-called small invention can be made a like bonanza. We do insist that under the law every improvement is patentable, and no man or men in the Patent Office have the right to say how much this improvement shall be before the patent can be granted.

Progress of the Russian Petroleum Industry.

It is claimed by an English writer that although the photometer indicates that the ordinary American oil is capable of yielding in the best lamp a greater amount of light, irrespective of the quantity of oil burned (especially when the lamp has been recently filled and trimmed) than the Russian oil affords in the same lamp, yet the latter gives what the consumer would call a good light, not only at first, but after several hours' burning, and actually furnishes more light per gallon of oil burned than is afforded in the combustion, under similar circumstances, of three out of five samples of ordinary American oil examined, and but little less light is yielded by an equal quantity of the American water-white oil tested.

The experiments made at the instance of the German Government have proved a like result, and European testimony is very clear on the question of quality. The crude naphtha does not give so large a quantity of burning oil as the American naphtha—only 25 to 30 per cent—but the low cost of the crude naphtha is so trifling, and the value of the 70 per cent of residue for the manufacture of other oils is so great, that the compensation is quite sufficient for the lesser quality of kerosene.

The conclusions arrived at are easily summed up thus: Russian kerosene (petroleum burning oil) will, without doubt, before long drive out the American oil from all parts of Eastern Germany—it has already done so from the towns near the Russian frontier. Gradually the same result will arrive throughout Austria and all the countries bordering on the Danube. Later, but also surely, American oil will be driven from central Germany, and from the countries near the Mediterranean Sea, while the lubricating oils and other products have already taken a firm stand in all the capitals of Europe—London included. One of the men who has done much to introduce naphtha products into Europe, M. Ragosine, is even sanguine enough to declare that he will sell machinery oils of Russian manufacture in America, and many of our burning oil makers are looking to London and Bremen as the future markets for large quantities of their products. They will not be contented with supplying Turkey, the East, China, Japan, etc., but want the larger and nearer markets of Europe. They couple with this the use of masouta, or liquid fuel, as something which will give Russia a large export trade and enrich the country by thus disposing of the large supplies nature has given her.

Permeability of Silver for Oxygen Gas.

BY L. TROOST.

THE author proves that pure oxygen and the oxygen of atmospheric air are capable of passing through the sides of a heated tube of silver, while a mere trace of nitogen penetrated the metal. Carbonic monoxide and dinoxide also permeate silver, though more slowly than does oxygen. The author suggests that pure oxygen may be obtained from the air on this principle. The temperature of the metal must not exceed 800°.

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ENGINEERING INVENTIONS.

A fascine for the protection of harbors has been patented by Mr. Jacob Elmer, of Biloxi, Miss. It consists of a tubular body made of saplings bound together and filled with stones, the diameter of the fascine to be from one to three feet, and its length from ten to forty feet, for the protection of harbors and banks of rivers and filling of crevasses.

A spark arrester has been patented by Mr. James N. Weaver, of Sayre, Pa. This invention covers improvements on a former patent issued to the same inventor, and includes certain means whereby cinders or dirt are prevented from being drawn into the valves or cylinders, an even draught on the fire is secured, and an increased length of smoke stack within a given space is obtained, with other novel features.

A car coupling has been patented by Mr. Patrick Ryan, of Guelph, Ontario, Canada. The drawhead has a pivoted coupling hook, with a transverse bar under connected with a bar having the outer end pivoted to the car, and the inner end pivoted to the transverse bar, the inner end of the pivoted bar being connected with a spring for pulling or pressing it upward, and pressing the coupling hook up into the drawhead.

A steam boiler has been patented by Mr. William F. Hatcher, of Chariton, Iowa. This invention relates to improvements in boilers designed to heat houses, the boiler being cylindrical, with an inner concentric shell extending from the bottom of the cylinder to the crown sheet, and extending across the shell at its upper end, thus forming a continuous cylindrical waterspace closed at the bottom and opening at its upper end into the steam and water space, and keeping up a constant water circulation.

MECHANICAL INVENTIONS.

A bench hook has been patented by Mr. James McVane, of Boston, Mass. It is constructed with two bolts held to slide vertically on a plate, the bolts having their lower ends pivoted to the ends of a lever pivoted on the plate, whereby one bolt will be raised when the other is lowered; the bolts can be locked in place by a latch, and the hook can be used for holding planks on the bench flat or edgewise.

AGRICULTURAL INVENTIONS.

A grain sower has been patented by Mr. John B. Wright, of Ridge's Creek, N. C. This invention covers a combination of harrow with pivoted beam, supplemental beam pivoted thereto, and carrying the driving wheel, lifting handle, catch and cord, semicircular hopper, with other novel features of construction.

A plow cleaner for sulky cultivators has been patented by Mr. Charles E. Ridley, of Mapleton, Iowa. A scraper is connected with the plow beam, the arched axle, and the coupling sleeve of the cultivator by bars so arranged that the partial revolution of the sleeve will move the scraper downward and the plow beam and plow plate upward, with other novel features.

A combined cotton cultivator and chopper has been patented by Mr. James W. Roberts, of Moody, Mo. A frame is mounted on wheels, with an axle, and carrying standards and beams connected with the frame by hooks and staples, and by levers for scraping and plowing the plants, with other novel features of construction, to facilitate the cultivation of cotton, and promote convenience in controlling the machine.

A novel quilting machine has recently been patented by Mr. Evans Wood, of Lyons Station, Texas. Combined with a needle frame adapted to carry a series of needles are a feed plate, eccentric shaft, rock shaft, and various special features of construction, it being designed to operate the machine at the rear of a cotton condenser of a cotton gin, so that the thick bat of cotton as it issues from the condenser may be fed between the upper and lower webs of cloth used for making the quilt.

MISCELLANEOUS INVENTIONS.

Improved neck wear is the subject of a patent issued to Mr. Howard Selvage, of Brooklyn, N. Y. The invention consists of a neck wear shield with a diagonal or oblique edge, a pin projecting from the edge adapted to hold the free end of the neck band.

A moistening case for cigars has been patented by Mr. Charles N. Swift, of New York city. The invention covers a tobacco case, with a removable perforated bottom, and a removable moistening tray, sliding beneath said bottom, so the cigars can be kept moist by the moisture in the tray.

A grain cutting machine has been patented by Mr. John B. Frost, of Cuyahoga Falls, O. Combined with a revolving hollow feeding drum, with apertures through the rim, is a reversely revolving cutter drum, with cutters and gauges, and various novel features of construction and arrangement.

An earth scraper has been patented by Mr. David Harper, of Jonesborough, Ark. The scraper bowl has a point at one side of its forward end, and the forward edge of its bottom slanting rearward from this point to the opposite side of the scraper bowl, the lower side corners of the scraper being grooved.

A pillow sham holder has been patented by Mr. Jonathan A. Pierce, of Austin, Minn. This invention provides a simple and inexpensive device for holding pillow shams in place over the pillows of a bed, and for holding the shams in raised position while the bed is in use, or when being made up for the day.

A cuff retainer has been patented by Agnes L. Franklin, of Frankfort, Ky. This invention consists of a pointed stud attached to the sleeve button, and capable of engaging the edge of the sleeve under which the cuff is worn, the object being to provide a simple and convenient device for retaining cuffs in place upon the wrist.

A middlings purifier has been patented by Mr. David L. Ellis, of Brookville, Pa. This invention consists in certain novel features of construction in the grading reel, in the screens, in the arrangement of the air passages, in order to give a machine of large capacity on little floor space, and save grading machines, spouting, and other now needed appurtenances.

An automatic register for grain, feed, and other substances has been patented by Mr. John Wherry, Jr., of of Putnam, Ill. This invention is to improve registers formerly patented by the same inventor, and by novel features of construction renders the meter less liable to become choked or clogged, and consequently more reliable in operation.

A shaft buckle for harness has been patented by Mr. Felix A. Bennett, of Prather, Ind. It is a device for single harness contrived to be hitched in the trace and buckled around the shafts in a manner to provide simpler and more substantial means for connecting the shafts, traces, back strap, and belly band than is afforded by other means now in use.

An adjustable desk and seat has been patented by Mr. Herman W. Groebl, of Vincennes, Ind. This invention covers peculiarities of construction whereby school seats and desks, office desks, etc., can be adjusted higher or lower, as desired, and locked in position, the seat being adjusted independently of the desk, and the desk independently of the seat.

A stop watch has been patented by Mr. Samuel C. Scott, of Brooklyn, N. Y. The invention consists in an adjustable hollow arbor, attached to or a part of the arm of the lever for operating the chronograph mechanism of a watch movement, the arbor to receive the square winding arbor of the watch, the shoulder of which winding arbor operates the said lever.

A hand power lifting and force pump has been patented by Mr. Olof Patterson, of New Boston, Ill. This invention covers a novel construction to facilitate the raising of water from any depth, with a minimum of power, and to reduce the wear on the working parts and the amount of attention necessary for keeping an efficient pump in order.

A saddle for horse collars has been patented by Mr. Christopher G. Calo, of Newark, N. J. The invention consists in a saddle constructed to fit upon the top of a horse collar, with side loops to receive thill or tug straps, so the thills or tugs can be supported from the collar, and with other novel features to simplify the construction and cheapen the manufacture of harness.

A garbage separator has been patented by Mr. George T. Waldeck, of New York city. The invention provides a reciprocating screen with a chute, a water tank with a chute, and drums journaled in the tank, an elevator belt, and operating devices, constituting an apparatus for separating ashes, cinders, and other powdered refuse from bones, rags, and coarse garbage.

An ear guard has been patented by Mr. William T. King, of Grand Rapids, Wis. The invention covers a combination of plug to fit into the ear, a pad to rest on the face, braces, and a spring hook, to protect the ear from being injured by loud and sudden sounds, such as the firing of artillery and the noise of mills, as well as to protect the ear from wind or cold, from insects, etc.

A car heater has been patented by Mr. Richard H. Brown, of Omaha, Neb. In combination with a stove extending above and below the car floor, there is a tank below the floor and a coil within the stove connected with the tank, with other arrangements for making a low pressure steam heater, designed to prove more efficient and safer than heaters now in use.

A carpet stretcher has been patented by Mr. William Hill, Jr., of Limestone, N. Y. The stretcher has a toothed head pivoted to a lever, in combination with a pivoted bar, having a pivoted dog, and other novel features, so the operator may fasten the stretcher with the carpet held in position and tack down the carpet leisurely before proceeding to stretch a second piece.

A carpet stretcher has been patented by Mr. Charles A. Cooper, of Chicago, Ill. The invention consists in a metal plate or drag with teeth at one end, the other end being connected by a loop with a slotted lever, a curved projecting from the plate on the opposite side from the teeth; the teeth enter the carpet from the under side, and therefore cannot injure the face of the carpet.

A process of moulding plastic substances has been patented by Mr. Chester A. Weller, of New York city. This invention provides a specially contrived press for moulding clay, artificial stone, etc., having a cylinder with an opening in its bottom, a spindle carrying screw blades journaled therein, a sliding platform under the cylinder, a mould plate hinged to the platform, with other novel features.

A sleigh knee has been patented by Mr. Laurent Jacques, of Lake Linden, Mich. Combined with a sleigh knee or leg are hook rods held in grooves in the side of the leg end, passed through the cross piece and having nuts screwed on the upper ends; rods projecting upward from the runner pass through longitudinal grooves in the front and rear sides of the leg and through the cross piece.

An earth scraper has been patented by Mr. William H. C. Goode, of Sidney, O. By this invention about one-half the material of the ordinary back plate is saved by curving up the rear end of the bottom along the curved rear edges of the sides, and the back is thus made curved from bottom to top without the necessity of forming the sides in separate pieces from the bottom.

A combined rule and square has been patented by Mr. George D. Umland, of Osceola Mills, Wis. The invention consists in attaching to or forming on the end of the jointed rule a metallic abutment block, which, when the outer section is folded inward, laps over the knuckle joint at the middle of the rule, and forms a stop, against which the other section of the abuts when it is exactly at right angles.

A transmitter for telephone time systems has been patented by Mr. Charles W. Ruehle, of Detroit, Mich. The invention consists in combining with a clock movement a circuit controlling apparatus to send electric signals at one second intervals, an intermitting device for discontinuing them at fixed periods, and stopping and starting mechanism for determining time of sending signals and limiting their duration.

A side spring carriage has been patented by Mr. Antipas P. Marshall, of Lancaster, N. H. By this invention the springs have their ends extended or spread out laterally relatively to the main portions of the springs, and the links are of correspondingly increased width, with shackles to conform, thereby giving bearings of increased width, to prevent side spring carriages from swaying or swinging sidewise.

A device for casting printers' leads has been patented by Mr. Arthur H. McClure, of Buffalo, N. Y. The invention covers a simple hand apparatus, in which two frames are hinged together, with plates on their inner faces, one of which is adjustable, to make leads of different sizes required, whereby printers may conveniently use old leads or type metal to recast into new sizes of leads as they require them.

A lifting jack has been patented by Mr. John W. Clarke, of Hallowell, Me. With an adjustable or extension standard is combined a lever for operating the lifting block, and straps or cords in adjustable connection with the lever and block, making a double adjustment, giving great lifting power with little weight, and the construction admitting of the jack being used from either the front or back of a carriage wheel.

A sun dial has been patented by Mr. Hugh G. Christian, of Chagrin Falls, O. This invention combines two half ring dials with longitudinal lines and transverse slightly curved lines, with two balls, the dials being supported on pivots, and having means for adjusting them for different latitudes, one scale and one dial being for each half of the year, and the dial being calculated to give the time by five-minute marks.

A permutation padlock has been patented by Messrs. Charles E. and Albert G. Smith, of Washington, Ga. By this invention the sliding bolt is provided with a thumb piece projecting through the case for operating it, there are oppositely revolvable disks with recesses in their adjacent peripheral edges, so when brought into alignment with each other and the bolt, the bolt may be thrown or retracted, with other novel features.

A lifting jack has been patented by Mr. Gardner Huntting, Jr., of East Hampden, Me. An axle support is connected with a standard by pivoted links and levers, the lower ends of connecting bars being pivoted to the latter, the bars having their upper ends pivoted on the axle support, so the support will be raised and locked in place by swinging the lever down against the standard, thus making a simple, light, and strong jack, without screws, catches, or springs.

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Name and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or mail, each must take his turn.

Special Information requests on matters of personal rather than general interest, and requests for **Prompt Answers by Letter**, should be accompanied with remittance of $1 to $5, according to the subject, as we cannot be expected to perform such service without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Minerals sent for examination should be distinctly marked or labeled.

(1) G. W. C. asks how to make a copying pad for copying letters. A. A recent formula for this purpose is the following:

Good ordinary glue	100 parts.
Glycerine	50 "
Barium sulphate (finely powdered)	25 "
Water	3·75 "

(2) D. W.—The use of diluted salt water is regarded as a most excellent tonic for the eyes; as to whether its use will permit the laying aside of glasses is a consideration which depends upon so many circumstances that we cannot answer it. Certainly, however, it can be said that, if the glasses are worn for weak eyes, quite likely they may be given up.

(3) E. A. K. asks if there is any kind of sheet iron or steel which will stand the heat of molten cast iron better than wrought iron. A. There is none.

(4) F. Q. asks the temperature of an egg to hatch. A. The temperature in incubators is steadily maintained at 102° to 104° Fah.

(5) E. J. K.—To soften paint brushes that have become hard, soak them twenty-four hours in raw linseed oil, and rinse them out in hot turpentine, repeating the process till clean; or wash them in hot soda and water and soft soap.

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(6) P. O. D. asks if there is an instrument or liquid that, by placing on the ground, will indicate where are mineral substances, such as iron, silver, or any mineral. A. There is no satisfactory method of determining mineral deposits except by having an examination by an expert mining engineer. The compass will indicate the presence of iron, but unless used by a competent individual would be unsatisfactory.

(7) M. E. E. writes: I am anxious to learn how to preserve natural flowers. Could you give me the process in this way? A. Dip the flowers in melted paraffine, withdrawing them quickly. The liquid should be only just hot enough to maintain its fluidity, and the flowers should be dipped one at a time, held by the stalks and moved about for an instant to get rid of the bubbles. Fresh cut flowers, free from moisture, make excellent specimens in this way.

(8) J. T. V. asks: What is Crême d'Argent? Please give formula. Would its application to stamp mill copper plates be advantageous before the first application of quicksilver, and prevent the rising of the oxide of copper through the quicksilver? A. Crême d'Argent is silver cyanide. Its application is to produce a silver coating in Hamerton's positive process of engraving or etching. We think it would be too expensive for your purpose.

(9) J. P. W. asks in what book he can get information concerning the method of analyzing phosphates and other commercial fertilizers. A. This information can readily be obtained from any text-book on analytical chemistry, such as Fresenius' Hand-Book of Quantitative Analysis or Cairns' Manual of Quantitative Analysis.

(10) B. B. S. writes: Will you please let me know if there is some cheaper copying process than the electric pen that will do good work? I wish something for examination papers in school, so I can take impressions from same. A. Use the hektograph, described in our SUPPLEMENT, No. 443.

(11) C. N. L. asks if there is any sulphurous odor at or near the locality where lightning strikes. A. There is an odor of ozone. There might be a sulphurous odor if the lightning should strike anything containing sulphur.

(12) J. B. asks if paper pulp can be run into moulds, and if it can be hardened, and to what extent, if so. A. It can be pressed into moulds, and if mixed with size will become hard when dry. Clay is sometimes added to the pulp.

(13) J. W.—We think the process you refer to is not nickel plating, but tinning. The knives are first thoroughly cleaned, then brushed with soldering fluid, then dipped in a bath of melted tin. The tin is covered with wax or tallow to prevent oxidation. We know of no practicable process of nickel plating without a battery.

(14) W. L.—London cement, for mending broken glassware, china, ivory, etc., is prepared by boiling Gloucester cheese three times in water, each time allowing the water to evaporate, and taking the paste thus left and thoroughly incorporating it with dry quicklime. It will mend glass, wood, china, etc., very effectually.

(15) T. L. G. says: I have heard stated that four persons could lift a heavy man from the floor without the least effort, by taking together a long, deep breath and putting their forefingers under the one to be lifted at the same time. If true, how can it be explained? A. If each of the four persons is able to lift one-fourth of the weight with his forefinger, there is no reason why four persons together could not lift the entire weight. There is nothing mysterious about it.

(16) C. C.—Coning the wheels is intended to prevent most or all of the sliding of wheels on average curves. If the curve and wheels are adapted to each other, there will be no slip.

(17) W. J. L. asks: What is a non-conductor to magnetism? I have tried a number of metals, but have not been successful; but I find loadstone will not attract brass, but it will attract through it. A. An insulator of magnetism has long been sought, but never found.

(18) E. M.—Siemens said that electrical engineering is simply an adjunct of mechanical or civil engineering. As a profession, apart from these, it would hardly be desirable. You can take a course at one or the other of our technical schools, or you can gain the practical part by engaging yourself in some branch of manufacture, or both.

(19) I. W. R.—Probably the readiest way to blacken the inner surface of your telescope is to mix lampblack with very thin shellac varnish and apply with a small sponge on a stick. Use a liberal quantity of lampblack and very little shellac. Try your varnish on a piece of metal before applying it to your tube.

(20) W. M. C. asks: Will a ship sink to the bottom of the sea, the depth being 5 miles, and the reason? A. If it would sink at all, it would go to the bottom. The reason is that water is practically incompressible, and a given bulk of water at the bottom of the ocean weighs scarcely more than the same bulk at the surface; and any body having greater weight than the water can as easily displace its bulk of water at the bottom of the ocean as at the top.

(21) T. D. M.—We think your method of destroying weeds, etc., by means of a heated roller would be impracticable, as earth is a very poor conductor of heat, and you would require not only a very hot roller but a very slow movement.

(22) W. R. C.—We cannot suggest a remedy for your difficulty without knowing more about the construction. Are the magnets strong? Have you used fine wire on your bobbins? Are your pole extensions very near the diaphragms? Is your fence wire perfect throughout, or is there a break or a bad joint somewhere?

(23) R. J. O'R. asks the present condition of the Hudson River Tunnel. A. On the New York side one tunnel has been built about 200 feet, through the bulkhead of the pier. On the New Jersey side one tunnel has been built 1,600 feet and another 600 feet. There is no work now being done, construction having been stopped for about a year from want of funds.

(24) J. D. G. asks a simple rule to determine the amount of condensation per square foot of surface on steam pipes of different thickness and temperature. A. We do not know of any simple rule such as asked for, but the following is the result of experiment. Steam pipes used for heating a room and maintaining a temperature of 60°, with good circulation, will condense 0·357 pound of steam per square foot of surface, each hour; a coil under similar conditions will condense 0 29 pound of steam.

(25) P. W. W. asks: Would not a lathe in which the slide rest is made to travel by means of a rack and pinion, cut a perfect screw? A. Certainly, only have a rack and pinion without backlash, and easily reversible. The method is not impracticable, nor is it new.

(26) W. R. P. writes: Will you please give me the best formula for making ink for copying pad? A. Try the following: Dissolve one part methyl violet in seven parts distilled water on the water bath, and add, when cool, two parts of glycerine.

(27) J. W. writes: I wish to learn how to make the bluing used by washwomen and sold by all the grocers. A. The liquid bluings are as follows: 1. Dissolve indigo sulphate in water, and filter. 2 Dissolve good cotton blue such as aniline blue 6 B in cold water. 3. Dissolve Prussian blue with one-eighth part of oxalic acid in water. 4. Dissolve Tiemann's soluble blue in water with 2 per cent of oxalic acid.

(28) J. J. McV. asks: What are considered to be the best materials and proportion of ingredients, color, etc., for paint, for outside iron work, like bridges of iron, railway and highway? A. There is nothing that stands wear and weather so well as red oxide of iron and boiled linseed oil. This may be tempered with chrome yellow, white lead, and lampblack for shades. On the great East River Bridge white lead is used. The elevated railways in New York are painted with Prince's metallic paint and chrome yellow. If it is not desirable to have the paint dry quickly, a little raw linseed oil mixed with the boiled makes an easier spreading paint and adds to its durability.

(29) J. H. asks how to make a cheap steam whistle, one that is loud, but not shrill. I intend to use a globe valve, if possible, so it will start to whistle gradually and die out gradually. A. A tinsmith could make you a steam whistle upon the same plan as an ordinary mouth whistle or an organ pipe, only on a large scale. We do not think that you can make one cheaper than the regular article of the same caliber.

(30) J. M. F. asks the latest receipt for the manufacture of carbon paper for use on the type writer. A. We know of no more satisfactory method than that of rubbing the surface of thin post or tissue paper with black lead and a little oil, and carefully removing the excess of coloring substance by rubbing with a clean rag.

(31) F. C. C. asks: In regard to the power of a small boat engine and boiler of the following dimensions: Boiler 11 inches diameter, 24 inches high, sixteen 1 inch flues, fire box 10 inches diameter, 14 inches high, engine cylinder 2x4 inches, 3 inch stroke, 40 or 50 pounds steam, half an inch feed. A. Your boiler, with good strong draught, would give you from 1¼ to 1½ horse power. The engine can furnish no more than the boiler is sufficient to supply.

(32) B. E. G.—The vessel from which the air is exhausted is lighter in consideration of the air extracted, therefore it will float easier than one containing air. The floating of a vacuum inclosed by a metallic case depends entirely upon the weight of the envelope.

(33) T. E. G. asks what he should use to paint a boiler with. Something that will not burn off. A. A coal tar varnish is very good, or the Norwood "smoke pipe paint;" the coal tar varnish can be obtained from gas works.

(34) W. S.—The reversal of the valves makes the cylinders act as pumps driven by the momentum of the engine and train, cushioning the steam before the pistons and driving it back into the steam chest and to the boiler, drawing steam and smoke from the exhaust pipe to follow after the piston.

(35) S. P. B. says: I use a two flued boiler 24 feet long, and use coal for fuel. I thought of making an experiment with coal oil to increase the heat in the flues by combustion of coal oil in atoms. I would conduct the coal oil to the flues through a quarter or half inch pipe. Would there be any danger in exposing the pipe, say a quarter or half an inch diameter, to a red heat? A. Not if of wrought iron. But a better way would be to send the oil into the furnace on a "spray" by a jet of steam, an operation similar to that of an injector.

(36) C. L. B. says: I am a machinist; have been oiler on several steamships, and wish to become an engineer. I am studying the indicator, and have learned to work up a card to a certain extent, but cannot understand the true curve, or theoretical curve, as it is termed. What I do not clearly understand is getting the cubic capacity of the cylinders. A. The length to be added to the length of the card is such a fraction of the working stroke of the piston as shall be equal to the cubic contents of clearance passages and openings from the valve to the piston when the latter is on its center, or extreme end of the stroke. If for instance the clearance was 1 inch and the stroke 40 inches, then the clearance alone would equal one-fortieth the contents of the cylinder, and if the cubic contents of the passages and openings, from the valve to the cylinder was equal to 1 inch length of the cylinder, then the clearance and passages would be equal to 2 inches length of the cylinder, or one-twentieth the capacity of the cylinder. It will be very difficult for you to understand the cards from a compound engine, except you make the subject a severe study or obtain instruction from some one familiar with taking, reading, and calculating such cards.

(37) J. W. R. asks: Does the crosshead of a locomotive engine move backward when the engine is moving ahead, and *vice versa*? A. The crosshead never moves backward upon the rail except when the wheels slip.

(38) H. W. B.—You may make a fusible alloy of tin 12 parts, lead 25, bismuth 50, cadmium 13, parts by weight, that melts at from 150° to 160°. A fusible alloy may be made of tin 1 part, lead 1 part, bismuth 2 parts, that melts at 200°. This may be tempered by adding mercury so as to bring the fusing point down to 150° or less. The alloys are conductors.

(39) J. L. H. asks how dry scale can be best separated from steam boilers. A. For removing scale Caustic soda dissolved in the feed water, about an eighth of a pound per horse power, and fed to the boiler one day each week, allowing it to remain all day and then blow off often during the next day, will soon remove the scale. After two or three applications the boiler should be thoroughly cleaned out, and examine angles or corners where deposits might accumulate and clean such deposits out.

(40) J. H. S. says: I want to get a tank to pickel beef in, either of zinc or galvanized iron, and would like to know which of them is preferable? Would such a tank be injurious to the meat? A. Zinc and galvanized iron are not as good for corning or pickling beef in as oak barrels or casks. Whichever is used, frequent cleaning is necessary. People are frequently made sick from eating corned beef, who are totally ignorant of the cause. Stale meat, saltpeter, and want of cleanliness in the pickle vat are at the bottom of this trouble; we recommend an oak tank.

(41) E. D. C. asks: 1. Can I drain a pond by means of a siphon made of 3 inch gas pipe 1,500 feet long with an 8 foot fall? A. You can drain the pond, provided the inflow is not as great as the outflow, by your siphon, which will deliver at best only about 40 gallons per minute. With a siphon the decreasing level in the pond would gradually lessen the flow. 2. Is there any rule by which a person can determine the distance that a pond can be drained under a given fall with a siphon? A. Rule for flow: Divide the constant for the diameter of pipe under one foot head by the square root of rate of inclination; the quotient will give the volume in cubic feet per minute. The constant for 3 inch pipe=73·5; the constant for 4 inch pipe=151. The rate of inclination is the length divided by the height.

(42) J. A. B. asks: Has the sulphur in the gas any influence on the bath in an open hearth furnace? Have there been any experiments made to investigate the matter, and if so, by whom, and where are the results published? A. The aim of iron makers is to keep the furnace as free from sulphur as possible, although probably a small percentage may not affect the iron. This can be ascertained by a trial, the visible effect of which is to make the iron *hot short*, or brittle at a red heat. The latest and best practice in iron making is described in various technical journals. For interesting details you may do well to examine articles published in SCIENTIFIC AMERICAN SUPPLEMENT —No. 24, Little's process; No. 55, Rees' process; No. 70 and 71, paper by Dr. Siemens; No. 157, direct process; No. 362, Sulphur in Iron and Steel; No. 282, Hay process; No. 364, Bromfield process; No. 380, Bull's process.

(43) J. H. L. asks about the process for the manufacture of picture mouldings, gilt and other plaster covered mouldings. And what book or in what way a person can procure practical instruction for the carrying on of such work. A. We have no knowledge of any work upon the manufacture of the ornamental or composition work upon picture frames. They are made by pressing a composition of oil and whiting in carved hardwood moulds or moulds cast in type metal.

(44) T. M. C. asks who or what is the best authority on the capacity of pipes for delivering water. Also, what quantity will an 8 inch pipe deliver, under 150 feet head, the pipe being half a mile long, and without much curvature? Also, what will a 12 inch pipe deliver under same conditions? A. Neville's Hydraulic Tables and Formulæ is high authority. Your 8 inch pipe will deliver 48 cubic feet per minute; 12 inch pipe will deliver 133 cubic feet per minute.

(45) W. S. V.—If it is a real fireproof paint about which you ask, the material constituting the fireproof qualities is probably composed of mineral or incombustible substances such as asbestos, clay, or pulverized slate or other cheap mineral colors, the resin and coal tar being only used in sufficient quantity to cement the real fireproof material.

(46) S. & D. write: We propose erecting tank for windmill pump; tank is to hold 50 barrels, and is to be elevated 30 or 40 feet. Will you be kind enough to tell us what pressure the tank will supply for water motor, size of connecting pipe 1 inch or 1¼ inch? A. For 30 feet elevation, 13 pounds pressure; for 40 feet elevation, 17¾ pounds pressure.

(47) F. J. S.—For carpenters' tonnage the rule is: Multiply together length, breadth, and depth, and divide the product by 95. You will find the various rules for tonnage in Haswell's Engineer's Pocket Book.

(48) B. R. N. asks for the mode of rendering horn transparent amber color, like tortoise shell. A. The imitation of tortoise shell with horn is as follows: Mix up an equal quantity of quick lime and red lead with soap lees; lay it on the horn with a small brush in imitation of the mottle of the tortoise shell; when it is dry, repeat it two or three times; or grind 1 ounce of litharge and half an ounce of quick lime together with a sufficient quantity of liquid salts of tartar to make it of the consistence of paint. Put it on the horn with a brush in imitation of tortoise shell, and in three or four hours it will have produced the desired effect. It may then be washed off with clean water; if not deep enough, it may be repeated. The original preparation consists in roasting the horn over a fire made of the stalks of furze; when rendered soft it is slit on one side, and kept expanded flat between a pair of tongs; it is then placed between iron plates, which are greased. The horns are suffered to remain until they are cooled; they are then soaked in water enough to be pared down to the required thinness, with a large knife worked horizontally on a block. Their transparency is thus acquired; and after being immersed in lye, they are polished with whiting and the coal of burnt willow.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

H. J. L.—The specimen is a hornblendic rock containing pyrites or iron sulphide, a mineral which frequently, if not always, carries gold with it. The amount of the latter, if any, can only be determined by assay. —L. D. B.—The specimen appears to be feldspar; it is so small that it cannot be easily determined without analysis.

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August 5, 1884,

AND EACH BEARING THAT DATE.

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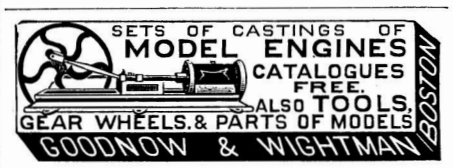

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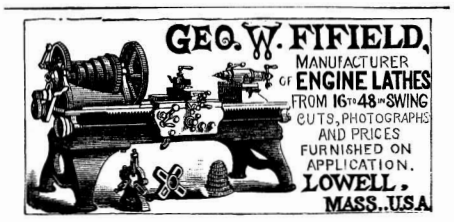

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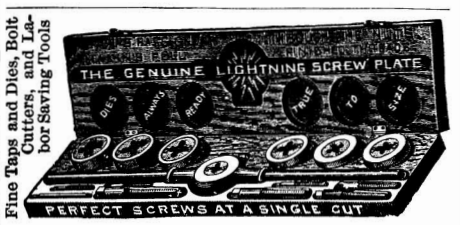

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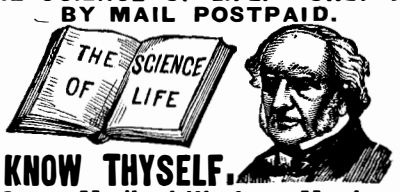

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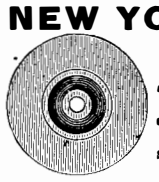

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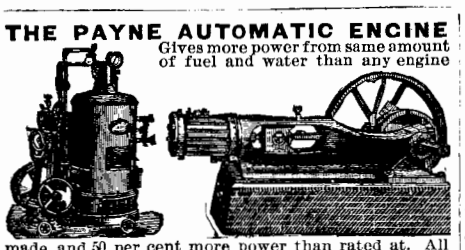

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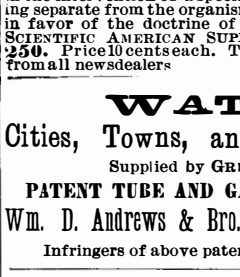

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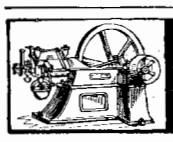

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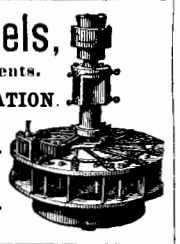

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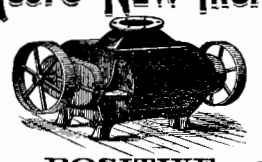

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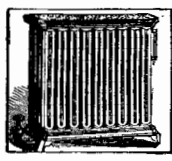

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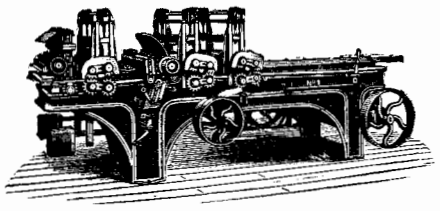

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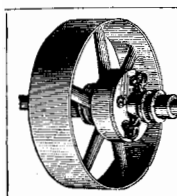

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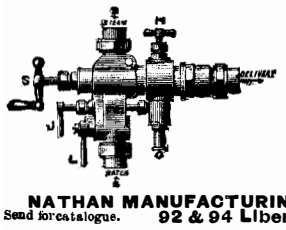

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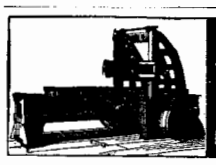

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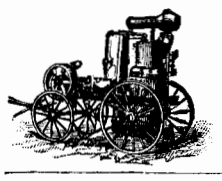

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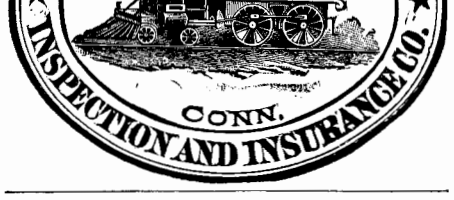

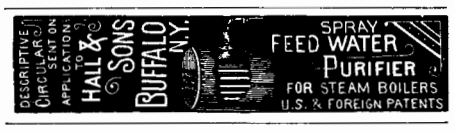

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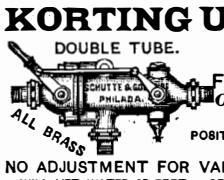

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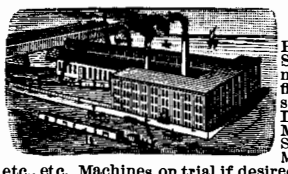

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